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WORK OF CENTRAL ECONOMIC-MATHEMATICAL INSTITUTE REVIEWED

Moscow EKONOMIKA I MATEMATICHESKIYE METODY in Russian No 6, Nov-Dec 79 pp 1228-1235

[Article entitled: "On the Work of the Central Institute of Economic Mathematics (TsEMI) of the USSR Academy of Sciences]

[Text] At a session of the Presidium of the USSR Academy of Sciences on 14 June 1979, conducted under the chairmanship of the president of the USSR Academy of Sciences, Academician A. P. Aleksandrov, the question of the work of the Central Institute of Economic Mathematics was considered.

A report was given by the director of the Institute, Academician N. P. Fedorenko. He underscored that the basic research of the Central Institute of Economic Mathematics of the USSR Academy of Sciences is directed toward the creation of theoretical foundations for the optimal planning and administration of the national economy and its individual links, including: the perfection of the methodology of centralized planning; the management and economic mechanism of the functioning of the economy; the rationalization of the organizational structures of management; the creation of data-processing systems, their mathematical and technical maintenance. In the decree of the CPSU Central Committee "On Measures Concerning the Further Development of the Social Sciences and the Increase of Their Role in Communist Construction", it was pointed out that the development of theory and methods of optimal planning and functioning of the national economy is one of the most important directions of the development of Soviet economic science, which demand the concentration of scientific and research work.

Academician N. P. Fedorenko emphasized that the development of a theory of the optimal functioning of the socialist economy is the direct continuation and development of the achievements of Soviet science of planning and managing the national economy, which has been developed by generations of Soviet academic and practical experts in economics. The theoretical foundations of the optimal planning and management of the national economy arose on the basis of political-economic and model research (from systems positions) of social production. And although the tasks put before the Institute are unusually complex, certain progress has been made with regard to their solution.

The Institute has published a number of works which illuminate the general theoretical and methodological problems involved in the development of a system of optimal functioning of the socialist economy. With the development of the concept of optimal functioning are connected the origin of ideas which reflect important realities of socialist production and must be examined as objective categories of the political economy of socialism and the theory of national economic planning. These are, above all, the ideas of the socio-economic optimum, the criterion of the optimum, the economic estimates, the optimal plan, and others.

The speaker dwelled on the contribution made by the Central Institute of Economic Mathematics to the development of the Complex Program of Scientific-Technical Progress and its socio-economic results. With the participation of other organizations, the Institute worked out the basic socio-economic problems of the longterm development of the national economy of the USSR up to the years 1990-2000, taking into account the acceleration of scientific-technical progress, and carried out all appropriate calculations and justifications. The Institute coordinated the work of the principal economic institutions (academic, departmental, industrial) that participated in the development of the Complex Program.

The Central Institute for Economic Mathematics also prepared proposals for the perfection of the system of management and planning, aimed at the acceleration of scientific-technical progress and the increase in the efficiency of production.

Theoretical research and the accumulation of practical experience in economic-mathematical modeling lead to the perfection of ideas about the mechanism of optimal functioning of the socialist economy. If the first theoretical models of optimization of the national economy described predominantly technical-economic correlations, which interrelated the output of production with the material and labor resources required for its manufacture, now all basic components of the planning and management of the national economy are examined in their interrelationship, including the process of planning itself, the operational management and regulation of the economic activity of all subsystems of the economy, and also the perfection of the organizational economic structure, the methods of management and economic levers, the development of the necessary informational-technical base.

At the present time, economic-mathematical modeling, the development of concrete algorithms and programs, and the execution of experimental plan calculations based on real information extend to practically all levels of our economy--national economic, industrial, territorial, the level of associations and enterprises, all phases of the reproduction cycle. A large part of these models is experimentally verified in concrete calculations and in many instances applied in practice, producing a considerable national-economic effect.

The apparatus of production functions and the econometric inter-industry model, and others, in particular, were applied in the development of the Complex Program of Scientific-Technical Progress and its socio-economic consequences. At the same time, the speaker noted that the development of the full set of tools for national economic prognoses still does not have a sufficiently clear character. The methodology of medium-term forecasting is not supplemented with a methodology of longterm forecasting that is coordinated with it. National economic forecasting is not integrated as yet with industrial and territorial forecasting, there has not been complete success in overcoming the difficulties in coordinating the methodology and results of scientific-technical prognoses.

A result of research on the perfection of the methodology of national economic planning were the proposals to build a system of complex national economic planning (SKP), in which the program-oriented method plays a central part. Within the framework of the SKP, the Institute developed a methodology for the construction of complex national economic programs which has been approved by the Council of the USSR Gosplan.

An important problem on which the Central Institute of Economic Mathematics continues to work is the development of the program part of the plan. The Institute has prepared corresponding materials to the plan for the Automated System of Plan Accounts (ASPR). The Central Institute of Economic Mathematics took an active part in the development of the basic sections of the draft plan of ASPR.

Recently there has been a significant improvement in the mutual understanding of planning-economic organs and scientific organization in the solution of concrete problems. In particular, in accordance with the assignment of USSR Gosplan in 1977, a project of methodological instructions has been prepared with regard to the development of complex programs aimed at the solution of the most important inter-industry and regional national economic problems. Research has been completed on the description of a technological set-up for the development of a longterm plan, in which the basic ideas of the system of complex national-economic planning were further developed.

A cycle of methodological and experimental work has been carried out with regard to the construction of a system of models for the optimal planning of the national economy which envisages the coordination of industrial and regional decisions and an estimate of the social balance of the plan. The experimental elaborations of the Institute have confirmed the fundamental efficiency of such a system of models. In the draft plan of the ASPR, prepared by the chief computing center of USSR Gosplan jointly with scientific organizations and confirmed by USSR Gosplan, the development of work on such a system of models within the limits of the subsequent development of ASPR.

Together with the Main Computing Center (GVTs) and USSR Gosplan, work has been conducted for a long time on the development of a multi-step system of optimization of long-term national economic plans. Unfortunately, because of the passive attitude of a number of ministries toward the development of the initial information for such a system, it has been impossible to carry its realization through to completion. On the basis of experimental constructions that have been carried out, basic methodological propositions of the multi-step optimization of longterm national economic plans were prepared, which have been presented to USSR Gosplan.

Further work in this direction must include the perfection of a static, as well as the development of dynamic, system of multi-step optimization, which has already begun. There are still a number of unsolved problems here, both of a theoretical and, especially, informational, character.

One of the new directions of research emanating from the established task of the perfection of planning is the problem of combined optimization of a group of interrelated industries which form multi-industrial complexes. Work along this line is being done: the conditions for isolating the multi-industrial complexes in the national economy are being studied; the structure of the tasks and the models of optimization of the development of such very important complexes as the fuel-energy, the polymer-petrochemical, the agro-industrial, the timber complexes, and others, is being developed.

Research in the sphere of the optimization of the development and distribution of the output of production of individual industries has especially advanced. On the basis of general conclusions drawn from the elaboratiors made by the Central Institute of Economic Mathematics, the Institute of Economics (IE) and the Department of Industrial Establishments of the Siberian Department of the USSR Academy of Sciences, and the Council for the Study of Production Resources (SOPS) attached to USSR Gosplan with participation of the specialists of a number of other organizations, a model methodology was created for calculating the optimization of the development and the distribution of production for the long term, utilizing economic-mathematical methods, which was approved by the Presidium of the USSR Academy of Sciences and USSR Gosplan.

Together with the leading institutes of the industrial ministries, practical tasks of optimizing the development and distribution of industries and factories from a long-term perspective were and are periodically solved. The results are utilized in the practical work of a number of organizations and departments for the solution of problems of the development and distribution of production in the coal, petroleum and gas industries, the distribution of nuclear power stations in the European part of the USSR, the production and use of plastics; the optimization of the structure of production and the distribution of chemical fibers and a number of others. Variants, calculated by using economic-mathematical models, make it possible to attain economies in current and capital expenditures in the amount of 10-15 percent. In recent times, such comparisons with "traditional" methods are already no longer being made since the efficiency of optimized calculations is evident, and a number of industries have made a full transition to their use. In the view of Academician N. P. Fedorenko, the solution of such tasks can and must be placed "on the assembly line". The time has come to prohibit ministries and departments from submitting draft plans to USSR Gosplan without carrying out appropriate optimization calculations. Together with the Main Computing Center of Gosplan, scientists are prepared to extend the necessary methodological assistance to every ministry.

The Institute has also elaborated a number of other models. Thus, research has been carried out on the composition of differentiated accounting balances of the incomes and demands of the population for the country as a whole and for individual regions. Methodological instructions concerning their elaboration have been prepared, the creation of methodological bases for the construction of differentiated plan balances is continuing. Unfortunately, obstacles which are most diverse in their complexity and character still stand in the way of the introduction of these models, obstacles which are to a large extent determined by the absence of necessary statistical information.

The speaker noted that economic-mathematical models are already working today in our national economy, are making a weighty contribution to the perfection of planning, but the effectiveness of their utilization may be considerably enhanced by virtue of the complete inclusion of all basic sections, parts, and levels of the plan, i. e., by virtue of the integration of the individual models in the system. With the transition to this qualitatively new phase of the development of economic-mathematical modeling, the unity of initial theoretical positions, the complexity of all work on the perfection of the system of management of the national economy, becomes especially urgent. In connection with this, a great deal of attention is given in the work of the Central Institute of Economic Mathematics (TsEMI) to the problems of the perfection of the economic mechanism.

In this sphere, too, a number of important results have been achieved in recent years. For example, in the methodology now operative for the determination of wholesale prices for new products intended for production and technological purposes, the recommendation concerning the determination of the marginal price according to the last sphere of the application of the new technology has been accepted. Recently an active collaboration has been established with the USSR State Committee on Prices, a number of proposals have been prepared for it, an interesting experiment is underway in regard to the calculation of prices with the aid of an electronic computer.

Together with a number of institutes, including the Institute of Economics of the USSR Academy of Sciences, has elaborated, and USSR Gosplan, the USSR State Committee on Science and Technology, the USSR Academy of Sciences, and the USSR State Committee for Inventions and Discoveries have approved, a methodology (basic propositions) for the determination of the economic effectiveness of the use of new technology, inventions, and rationalization proposals in the national economy.

With the participation of the Institute, basic propositions were prepared concerning the methodology of the economic estimate of natural resources in mass plan-perspective calculations, the methodology of the economic estimate of deposits of useful minerals, approved by the Presidium of the USSR Academy of Sciences and the USSR State Committee on Science and Technology, as well as methodological foundations for the economic estimate of land, water, forest, which are undergoing experimental verification. At the present time, a project is being concluded involving the methodological bases for the determination of damages from the pollution of the environment.

With the participation of TsEMI, an experiment was begun and is being conducted on the perfection of the planning and management in the Main Administration of Automobile Transportation of the Mosgorispolkom (Glavmosavtotrans), and primarily in the Automobile Combine No 1. Here research is being done on the possibilities of using the standards of prolonged operation in the management of production, various forms of local criteria, the methods of cost accounting incentive and management, based on the mutual material responsibility and interest of the internal links of the combine in the attainment of the plan targets for the combine as a whole. An automated system of transports and technical services management has been created. This system has been turned over to the Automobile Combine No 1 for implementation. An interdepartmental commission attached to USSR Gosplan summed up the course of the experiment and approved the results.

At the present time, the bases of the economic experiment of Glavmosavtotrans are being disseminated to the ministries of automobile transportation of Latvia, Belorussia, Kazakhstan, and Georgia.

The research on problems of material-technical supply has become one of the practical applications of the theory of optimization. The Institute has developed basic propositions for an automated system of management of material-technical supply for the national economy, as well as the methodological bases for the creation of complexes of economic-mathematical models of optimization of economic relations. After extensive experiments, the USSR State Committee for Material and Technical Supply (Gossnab), the USSR State Committee for Science and Technology, and the Presidium of the USSR Academy of Sciences approved a model methodology for calculating the optimal plans of registration in the Main Administration of Materials and Equipment Supply and Marketing (Soyuzglavsnabsbyt) of Gossnab, thanks to which these calculations in the course of the last few years have been used in the planning of supplies for hundreds of production designations, and the savings effected amount to many millions of rubles and tens of thousands of railway cars.

In the sphere of research on the economic mechanism, a number of shortcomings and unsolved problems can be noted. As yet sufficiently complete recommendations concerning the organic linkage of economic levers with the centralized plan have not been developed; still lacking is a methodology for the economic estimate and determination of the dimensions of payment for labor resources; not brought up to the required level is the theoretical foundation for the level of payment for assets, and so on. At the present time, imitation models have been developed for the experimental research of such questions; however, they operate for the time being on conditional information and do not supply a practical conclusion. The lack of coordination in systems research, which is reflected in a certain separateness of the models for the various aspects and levels of the economic hierarchy, has not been overcome. The establishment of all necessary interrelations among them, the theoretical substantiation of the whole picture of the functioning of the economy must be acknowledged as a primary task of the near future.

An important direction of the work of TsEMI is the research devoted to the development of a methodology for the creation and development of an automated system of control. This work, which is carried out in close conjunction with other scientific organizations and institutions of higher education, and especially with the Ministry of Instrument Making, Automation Equipment, and Control Systems (Minpribor) of the USSR and the Administration for Computer Technology of the USSR State Committee for Science and Technology, from the very beginning was based on the organic combination of theoretical research and the lending of support by ministries, departments, associations and enterprises. The general principles for the design of automatic control systems (ASU) and the complexes of economic-mathematical models necessary for them, which have received recognition in the country, were developed and substantiated. The results of the theoretical research in the sphere of the methodology of ASU have been experimentally verified in practical conditions of the activity of industries, associations, and enterprises. Through the efforts TsEMI specialists with the participation of collaborators of the relevant departmental organizations, plans have been prepared for automated systems of management for a number of industries in machine building, industrial enterprises (Moscow Krasnyy Proletariy Machine Building Plant imeni Yefremov and others)

The organic combination of theoretical research and experimental work have guaranteed the preparation and practical utilization of the methodological materials for the creation of automatic control systems on all levels of the national economy. The Institute took part in the preparation of instructional-methodical materials for the organization and development of an industrial automatic control system and an automatic enterprise control system (OASU and ASUP), which have been approved by the USSR State Committee for Science and Technology.

The analysis of the work in this sphere shows the necessity of concentrating research on questions of automatic control systems in TsEMI on the problems of the synthesis of automated control systems and the economic mechanism and the organizational structure of control.

Work was actively pursued in TsEMI on the perfection of the mathematical apparatus which is being used in economic research and answers the purpose of program guarantee. The development of this direction was determined by the necessity of the practical solution of the tasks of the economy. Thus, the basic attainments in the sphere of linear programming are connected with the development and perfection of the methods of solving the tasks of large dimensionality. Model programs that have been developed are regularly published by the Institute in the collections "Programs and Algorithms". It is necessary to speed up the resolution of the question of equipping the Institute with highly productive electronic computing machinery, which is necessary for the development of applied research on all levels of modelling of planning processes and the perfection of the economic mechanism.

During recent years considerable work has been done to improve the planning of scientific research, to eliminate the multiplicity of research subjects, to concentrate the efforts of the collective of TsEMI on the most important scientific problems. The transition of the Institute to the program-oriented principle of the planning and administration of scientific research work, which was begun in the years 1974-1975, was called upon to promote an increase in the qualitative level of the organization of research. Proceeding from the basic direction of scientific research, a complex program of research was approved: "Optimal Planning and the Management of the National Economy", its subprograms and the leading divisions in regard to their realization. From the moment of its organization, TsEMI, together with the Scientific Council of the USSR Academy of Sciences, has been conducting work on the complex problem of "Optimal Planning and the Management of the National Economy" with regard to the unification of efforts of scientific organizations and institutions of higher education, of all union republics, in the execution of scientific research in the sphere of the application of mathematical methods and electronic computers in the economy.

The Institute has extended and continues to extend important assistance to the union republics in the preparation of scientific cadres with high qualifications. Such preparation is being accomplished through postgraduate training as well as through providing regular scientific consultation and the attachment to the Institute of research personnel on a probationary basis for extended periods of time. Seminars, lectures, joint conferences and schools, workers' meetings are conducted for the scientific oeganizations of the republics.

In conclusion, the speaker dwelt on some unsolved problems and directions for further research. He emphasized that the creation of a system of optimal functioning of the economy (SOFE) cannot be a one-time only act. We distinctly understand, said Academician N. P. Fedorenko, that at this time only the foundations have been laid, the contours have been drawn of a theoretical conception of the optimal functioning of the economy. We are convinced by the practical results that its general direction, which has been creatively developed in our country, is correct. Experience has shown the necessity and the possibility of a gradual "adjustment process" of the various elements of the system of optimal functioning in the practice of planning and management on all the levels of our economy--which is attested by the successful application of a number of principles and methods of the optimal functioning of the economy on the level of the national economy, industries, and interindustry complexes. In the course of further research and elaborations, no doubt, a great deal will be refined and corrected. It must be acknowledged that research work on the problems of the creation of a system of optimal functioning of the economy has not always sufficiently active and purposeful. Many elaborations were carried out slowly and without coordination. This applies to theoretical research as well as the experimental verification of systems of economic-mathematical models, the preparation of practical proposals for the perfection of planning and control.By far not everything has been done by the scientists of the Institute to secure a durable connection with the practice of planning and control of the national economy.

The entire work of the Institute must be subjected to a common direction, which unites all sections and spheres of the research that is being done (forecasting, planning, economic mechanism, organizational structure, informational-technical and mathematical provision, and others), which must be directed toward the increase in the efficiency of socialist public production and the strengthening of the economic power of the country.

Among the primary tasks of the Institute, which follow from what has been said, one can point to the following:

the elaboration of a single system of models which organically combine all levels of planning and control in unity with the economic mechanism of the composition and the realization of the plans;

the creation of a system of interrelated methodic materials, including the technology of planning on all levels, economic levers and informational-technical provision;

the improvement of experimental work (in the sphere of real as well as imitation economic experiments). The relations between science and the practice of planning and control. At present this relationship has not been put into effect the way it should because a number of scientific recommendations have not been worked up sufficiently concretely and also because a certain inertia is observable among some practical workers, and sometimes there is the actual manifestation of the attempt to limit the perfection of planning and control to insignificant specific corrections.

A further increase in the theoretical level of research lies ahead. In addition to various types of planning and methods materials and recommendations, this must result in a summary work on the problems of the perfection of planning and control of the national economy, with the preparation of which the Institute has already begun.

The chairman of the commission for the verification of the work of TsEMI, Academician N. N. Inozemtsev (Institute of World Economics and International Relations), expressed his agreement with the speaker concerning the focus of attention of the Institute in the future. He especially underscored the importance of the concentration of efforts on the problem of increasing the effectiveness of socialist production. From the energy, raw material, and materials already produced, the already available capacities in various sectors of the economy, a much larger final effect can be obtained than is the case today. In these conditions, the basic efforts of economic science in the coming years must be directed toward the search of how these possibilities can be realized concretely.

TsEMI has done considerable work with a number of ministries in regard to searching for ways of the optimal use of available resources. However, the operative economic mechanism by far not always provides the stimulus for the full realization of the reserves for increasing the efficiency of production. The task lies in the attainment of the use of the achievements of economic science to a much larger degree through common efforts.

N. P. Lebedinskiy (USSR Gosplan) noted that during the last years the collaboration of the Institute with a number of divisions of USSR Gosplan and in particular with the Main Computing Center has noticeably improved and has a constructive, fruitful character. This applies especially to the joint work on the creation of the automated system of plan calculations (ASPR). In the course of the creation of this complex and extensive system, which is without analogue in world practice, great theoretical difficulties were encountered from the very beginning, which provoked sharp discussions. But in the end it proved possible to work out a common point of view, which found reflection in the draft project. The project was approved at an expanded session of USSR Gosplan, the State Committee for Science and Technology with the involvement of a number of ministries, it has already become an official document. In this work, without a doubt, great merit belongs to TsEMI and its director, Academician N. P. Fedorenko, who is the scientific director of this system.

Having noted other concrete examples of collaboration, N. P. Lebedinskiy focused attention on the current problems of further research and existing shortcomings. Above all (and this is characteristic of many institutes), a number of models have an abstract character; true, during the past few years there have been fewer and fewer of those kinds of works. Interesting research is being conducted, for example, in the sphere of national economic forecasting, but for the time being they are still outside the sphere of elaboration of the automated system of plan accounts.

N. P. Lebedinskiy emphasized that, although the automated system of plan calculation (ASPR) is an important instrument in the perfection of planning, it does not encompass planning as a whole and does not is not a substitute for it. During the period of developed socialism the role of basic research in the sphere of the theory of planning grows considerably, which answers the current conditions of the development of productive forces. That which is being done with regard to the perfection of planning in a number of cases has a particular character. The theory of planning must attain a level which corresponds to the contemporary requirements for the administration of the socialist economy--which sets great tasks before TsEMI and other economic institutes. This theory must base itself on the most modern views of political economy, philosophy, and so on, not pull the weight of the past behind it.

N. P. Lebedinskiy expressed the conviction that TsEMI, where a great many highly-qualified specialists are working, will make a great contribution to the cause of the perfection of planning and control of the national economy.

G. L. Krauze (Automobile Combine No 1 of the Main Administration of Automobile Transportation of the Mosgorispolkom) told about the work of one of the largest automobile combines of the country, whose profitability--thanks to the use of new methods of planning and incentives--reached 40 percent, with the average profitability of automobile operations of Moscow being 10 percent. If today the mechanism for planning transportation with the aid of electronic computing machinery, introduced jointly with TsEMI, were destroyed, the existence of the automobile combine would become impossible, there would have to be a return to small automobile operations. Today the experience of the creation of large automobile enterprises of the type of Automobile Combine No 1 is being disseminated throughout the country. Plans call for the organization of a study center in the Combine for the purpose of the systematic transfer of the experience accumulated on the basis of collaboration with TsEMI.

After recalling that a plan for the collaboration of TsEMI with the automobile combine exists and is being implemented, G. L. Krauze said that what has been done is only the beginning of great and important work on the perfection of planning, which joint efforts must continue.

Academician L. V. Kantorovich (All-Union Scientific Research Institute of Sanitary Testing [VNIISI]) underscored that mathematical methods and models for the analysis of economic processes have received wide distribution only two decades ago. However, the practical application of the new methods and electronic computing machinery have not yet yielded sufficient effect. Of course, for 20 years the task of the transition to their daily and wide use could not be solved, especially as these methods were not valued at once. Gosplan and the State Committee on Prices, even where a certain change of viewpoints was achieved, were not sufficiently consistent. Critical remarks may be addressed not only to the economic organizations, but also to scientific institutions, including TsEMI, which are not always sufficiently insistent in the practical realization of their scientific accomplishments.

Academician L. V. Kantorovich pointed to the importance of the economic experiment. Like physicists and chemists, economists, too, must be given the possibility of testing new methods in practice. The work on the Complex Program demonstrated how important thorough economic analysis is. Closer collaboration of economists and other specialists is required.

Academician N. N. Nekrasov (Council for the Study of Productive Resources attached to USSR Gosplan) noted the works of the Institute that have to do with the development and distribution of production, which are unthinkable without economic-mathematical models. It is very important that in this work it proved possible to combine the scientific forces not only of the Academy of Sciences, but also the ministries and departments. However, the use of these methods in the elaboration of schemes for the socio-economic development of the union republics and economic regions at present is still in a rudimentary state. In the opinion of N. N. Nekrasov, this is one of the main directions in which work must be done in the immediate future.

V. I. Cheplanov (USSR State Committee on Prices) emphasized that in recent times some of the results of the research of TsEMI are being introduced in the practice of price formation. Besides the works mentioned in the report, he noted the participation of the Institute in the preparation of the reform of optimal prices.

Perspective, in his opinion, are the standard-parametric methods of price formation, the development and introduction of which was pioneered by TsEMI. Where these methods were applied in the national economy, there is no contradiction between old and new technology. At the time, these methods were rejected. Today it has been demonstrated that those methods, as well as all optimal planning, are strictly based on the Marxist theory of planning and price formation.

Of great significance for the perfection of price formation are investigations in the sphere of estimation of natural resources. Today the State Committee extends support to TsEMI for the purpose of introducing the methodology it has developed for the rational use of the natural wealth of the country. The Institute is taking part in the preparation of the impending review of the prices for ferrous metals with the Ministry of Ferrous Metallurgy and the State Committee on Prices. Such a calculation, until recently carried out by hand, took a great deal of time. What is of importance here is not only the saving of time and expenditures of those who work out the price list, measured in tens or hundreds of thousands of rubles, but in the receipt of prices which are optimal from the standpoint of the national economy, which will provide a stimulus for the economizing of the metal, lower the metal capacity, and find reflection in an effect of billions of rubles.

TsEMI must continue and expand its research in the sphere of price formation, the theory of socially necessary expenditures, the links of prices with the plan, the stimulation of progressive processes in the national economy.

Academician L. A. Melent'yev (Siberian Energy Institute of the Siberian Department of the USSR Academy of Sciences) dwelled on the works of TsEMI in the sphere of longterm forecasting of energy and the fuel-energy complex. These investigations are being conducted from the positions of the optimal planning and control of the national economy, which has great theoretical and practical significance since it guarantees the combination of the further development of the political economy of socialism with the application of means obtaining concrete quantitative decisions. L. A. Melent'yev noted the contribution of TsEMI to the development of the longterm problems of energetics.

In the opinion of Academician L. A. Melent'yev, TsEMI must devote greater attention to questions of the organization of control, its perfection taking into account the possibilities of using new means. Both the industrial institutes and TsEMI are occupied with the methodology of the creation of the necessary qualitative initial information for calculations to a lesser extent than with the elaboration of a strictly mathematical model. It is necessary to remember that when we speak about systems with a hierarchical structure this presents qualitatively new demands on mathematical models. In the latest works of TsEMI these questions are already being posed, the economic system is viewed as a stochastic system. In the opinion of Academician L. A. Melent'yev, this must not be carried too far. It is apparently necessary to talk about the fact that besides definite information there exists insufficiently definite or indefinite information.

Academician L. A. Melent'yev agreed with the remark of Academician N. N. Inozemtsev about the fact that in the research of TsEMI significantly more attention must be given to the problems of increasing the efficiency of the socialist economy.

Corresponding Member of the USSR Academy of Sciences Yu. A. Izrael' (Hydrometeorological Center of the USSR) noted the works of TsEMI in the sphere of the socio-economic aspects of the preservation of the natural environment and the use of nature. According to his view, it is inadequate to assess the effectiveness of environmental protection measures on the basis of the damage which it proved possible to prevent. This is only one side of the question. The other side is the increase in the national income per unit of ecological damage. It may happen that in some sector, where it was not at all necessary to build plants, there turns out to be a great deal of pollution, the fight against which produces a large effect, as it were, in a one-sided assessment.

It is necessary to turn attention to the economic estimate of the natural resources that we are not used to think about, for example, the climatic-shock-absorbing resources of the environment, as well as fuel and mineral resources which are used only partially (for example, during the burning of coal there is a residue of sulphur, vanadium, and mercury). Their extraction must be stimulated. Yu. A. Izrael' emphasized that scientific elaborations must lead to the result of making it economically unjustified to use the resources of nature above an ecologically admissible level. The question about the weather merits the attention of economists as well. In the planning of agricultural production, the cyclical character which is peculiar to nature must be taken into account.

Assessing the activity of TsEMI, Academician of the Academy of Sciences of the Ukrainian Soviet Socialist Republic I. I. Lukinov (Institute of Economics of the Ukrainian Academy of Sciences) pointed out that economic scientific institutions of the Ukrainian Academy of Sciences collaborate closely with the Institute on questions of the elaboration of the conception of the optimal functioning of the economy on the macroeconomic level, the optimization of economic processes on the industrial, regional and microeconomic level, the estimate of natural resources for the purpose of their complex and efficient use. He proposed to strengthen the political-economic research in TsEMI, to expand the elaboration of concrete models, reducing abstract constructions to a minimum.

O. V. Kozlov (
[MIU] imeni S. Ordzhonikidze) dwelled on the works of TsEMI in the sphere of automated systems of control. Having noted that the practical work here has gone more along the line of calculations than optimization, O. V. Kozlov emphasized the necessity of the further development of the theory of automatic control of production, of the continuation of this work in TsEMI.

V. A, Myasnikov (USSR State Committee for Science and Technology) spoke about the activity of TsEMI in the sphere of automatic systems of control. After expressing his full agreement with the positive assessment of the work of the Institute, he spoke in favor of the continuation of its work by TsEMI along the following lines: elaboration of optimization models for the development of industries and factories; perfection of the organizational structure; the further elaboration of the theory of automated systems of control.

Vice-President of the USSR Academy of Sciences Academician P. N. Fedoseyev said that TsEMI began work along necessary lines from the very moment of its birth. Planning has been conducted in the country from the time of the establishment of Soviet power, but its methodology and the technology of calculation were in need of perfection on the basis of the achievements of contemporary science. The Institute engaged in theoretical developments in this sphere, methods and models for various sectors of the national economy, mathematical securing. The services of TsEMI must be acknowledged as indisputable.

TsEMI must continue the elaboration of the theory of planning. The main goal here is the optimal development of the national economy. The Institute must turn attention to the central questions which are connected with the theory of expanded socialist production.

Although much has already been done with respect to the linking of models that have been developed with practice in the national economy, nevertheless the examples cited with the optimization of the plans of industries show that success is dependent not only on TsEMI, but also on the economic organizations. Apparently, a situation has to be achieved in which calculations of the optimization of industries become obligatory.

Academician P. N. Fedoseyev paid special attention to questions of the development of the Complex Program of Scientific-Technical Progress and Its Socio-Economic Consequences. It is necessary to perfect the organizational forms of its development, to achieve closer cooperation between scientists and USSR Gosplan in the solution of the questions of the preparation of national economic plans.

Academician P. N. Fedoseyev pointed out the necessity of providing TsEMI with the appropriate informational, as well as material-technical base.

Summing up the results of the discussion, the president of the USSR Academy of Sciences, Academician A. P. Aleksandrov emphasized that research, by way of increasing the efficiency of the national economy, must lie at the basis of the entire activity not only of the economic institutions of the USSR Academy of Sciences, but also of scientific organizations which conduct research in the sphere of the natural sciences.

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AGANBEGYAN DESCRIBES ECONOMICS RESEARCH IN NOVOSIBIRSK

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[Article by Abel G. Aganbegyan, member of the academy, director of the Institute for the Economics and Organization of Industrial Production of the Siberian Department of the USSR Academy of Sciences, specialist in the field of political economy and application of mathematical methods in economics research and planning: "Economics Research in the Novosibirsk Research Center"]

[Text] The decree of the CPSU Central Committee on the activity of the Siberian Department of the USSR Academy of Sciences (1977) emphasized that the growth of the scientific and technical potential of Siberia and the Far East must be aimed at speeding up in every way the development of the productive forces in the country's eastern regions. The efforts of the staff of the Institute for the Economics and Organization of Industrial Production (IEiOPP) of the Siberian Department of the USSR Academy of Sciences, which was set up in 1957 and today has about 200 staff scientists, have been aimed at achievement of that goal.[1]

The following have been defined as the main lines of scientific research of IEiOPP: development and location of industry, organization and management of production, the economics and organization of work, unused potential within the production entity, regional problems of Siberia and the Far East, production planning methodology, etc. It is a characteristic feature of the activity of the institute's specialists to have close contact with scientists in other specialties. For instance, creation within IEiOPP of the Mathematical Economics Research Laboratory in 1961 helped to strengthen relations with the Mathematics Institute and Computer Center of the Siberian Department of the USSR Academy of Sciences, as well as with other institutions of the country conducting research and mathematical economics.

An entire series of regional subdivisions was set up for the sake of the institute's more thorough interaction with planning and economic agencies of the most important regions of Siberia: Krasnoyarsk Economics Laboratory (1959), Division for Regional Economics and Location of the Productive

Forces of Eastern Siberia in Irkutsk (1968), Economic Forecasting Laboratory in Kemerevo (1968), Economics Research Division in Tyumen' (1968), Industrial Economics Laboratory in Barnaul (1972), and Tuva Economics Laboratory in Kyzyl (1974). These subdivisions, which perform the role of outposts of economic science in the respective regions, are extending practical and methods assistance to planning, research and economic organizations and institutions, educational institutions, and bodies of the party and the soviets in solving scientific and economic problems, are coordinating economic research in the region, and are supplying the necessary information and materials for research projects being conducted in Novosibirsk.

Lines of Research

The objective process of the development of economic science, which is conditioned by the qualitative and quantitative changes in the country's productive forces, led to the spread in the early sixties of the theory and methods of optimum planning of economic development, which are based on extensive use of the instruments of mathematical economics and electronic computers.

Three exceedingly important factors favored setting up work in mathematical modeling in planning economic development at the Siberian Department of the USSR Academy of Sciences: the theoretical foundation and new methods created by the outstanding scientists L. Kantorovich, V. Nemchinov and V. Novozhilov, the existence of a strong computer facility and widespread support in the scientific and public community. The scale and complexity of the outstanding problems in the economic development of Siberia and the Far East urgently demanded the broadest application of present-day scientific methods of multiannual planning--systems analysis and mathematical-economic modeling.

Optimization methods of solving local economic problems first became widespread in the USSR. But these methods did not make it possible to embrace such a complicated economic system as the national economy. The multilevel systems approach to modeling the development of the national economy was quite new and more appropriate. In accordance with the methodology of systems analysis, optimization of complex systems is preceded by definition of the ultimate goal of their functioning and by identification of all the elements, the complex of interrelated subsystems, which participate in its attainment. The Mathematical Economics Research Laboratory of IEiOPP was one of the first Soviet research groups to concentrate its efforts in this field.

Today development of a system of mathematical-economic models of optimum multiannual regional-production planning is one of the main lines of IEiOPP's scientific research.[2] It includes a broad range of research aimed at laying the scientific foundation of the system's structure; at developing particular types of models that would make it up; to define the requirements of the information necessary for applying the models and the requirements to be met by the methods of data collection and processing; the development of mathematical methods of solving the various models and iterative processes of linking them together; creation of algorithms and programs for present-day electronic computers for purposes of solving linear and enumerative optimization problems; experimental verification of the various models, of methods of solving them, of sets of models and of the system as a whole; creation of a method of mathematical-economic analysis of solutions and step-by-step introduction of models and the system as a whole into the practice of planning.

Development of a system of models for optimum multiannual regional-production planning necessitated research on the general theoretical aspects of optimum economic development, for example, selection of optimality criteria and the formulation and formalization of the goals of economic development.[3]

The fundamental scheme of the system of models for optimum regional-production planning, whose first variants were worked out back in 1961 and 1962, includes subsystems of models of summary national economic planning (determination of summary indicators of national economic development); regional planning of the national economy (determination of the principal indicators of the development and location of the productive forces by republics and economic regions of the country); optimum planning of complexes--for example, the fuel and power complex and the agroindustrial complex--and sectors governed by programs (determination of optimum variants of development and location of production for intersector complexes and individual sectors governed by programs); the regional level of planning (determination of the optimum variants of development and location of the productive forces within regions).

A peculiarity of this system of models is the principle of step-by-step model-building. Each stage in computation of the optimum regional-production plan is regarded as a completed cycle. Its results are comprehensively analyzed and corrected, and only thereafter is all the necessary information transmitted for solution of the problems of the succeeding level of the system. The principle of step-by-step model-building also makes it possible to introduce mathematical-economic models into planning practice step by step as the theoretical and experimental research is completed and as they are mastered by planning personnel.

Each component of the system is regarded as a self-developing subsystem. This approach makes provision in advance for building other components into the system: for example, models of formation of labor resources, of technical progress, of financial planning, etc. Moreover, the principle of self-developing subsystems requires that every subsystem be represented in the form of a group of interrelated models built up from a base model. For example, the base model of the subsystem of summary national economic planning is the dynamic model of the intersector balance. Static and dynamic variants of the base model of the balance of production capacities were used for a series of computations in preparing proposals for the 10th Five-Year (1976-1980) Plan for Development of the USSR National Economy. For the subsystem of regional planning of the national economy the base model is the intersector, interregional optimization model first realized numerically in 1967;[4] for the subsystem of complexes and sectors governed by programs it is a broad class of standard optimization models of planning the development and location of production within industries, and so on.

The mathematical-economic models of multiannual planning are widely used in working on the socioeconomic problems of the USSR's economic development. This is the second most important line of research of IEiOPP. It includes definition of Siberia's place in the country's national economy and optimum linkage of the problems of economic management, the needs that exist and the resources that are available. This research is being done jointly with divisions of USSR Gosplan and of its Main Computer Center, the USSR State Committee for Science and Technology, and a number of scientific research institutes, above all the Central Mathematical Economics Institute of the USSR Academy of Sciences (TsEMI).

This line of research has already yielded results. For instance, along with the proposals for the plan of the 10th 5-year period already mentioned, proposals have been advanced for improvement of the quality of centralized management of economic development, specifically concerning the specialized-program approach to planning and on improvement of cost accounting and the system of economic levers.[5] The institute took part in preparation of the Comprehensive Program of Scientific-Technical Progress and of Its Socioeconomic Consequences in the 1976-1990 Period.

Work on the economic and social problems of development and location of the productive forces in the regions of Siberia and the Far East on a multiannual basis is the third line of economics research in Siberia. Up until 1970 the problems solved in this field were important, but they were partial. Development of the methodology of mathematical-economic modeling, expansion of the network of scientific subdivisions of the Siberian Department of the USSR Academy of Sciences, mastery of the field-team format for research, and the staffing of the scientific team with qualified personnel have made it possible to move to a comprehensive study of the socioeconomic problems of the economy of the country's largest regions. Here the staff of IEiOPP sees its principal task to be in developing the theoretical foundations and conceptions of the economic development of Siberia over the forecasting period, developing new methods of studying a regional economy (using the principles of systems analysis, the program approach, etc.) and working on the problems of long-range regional planning and forecasting.[6]

Defining the conception--of a system of theoretical views on the most acceptable principles and techniques for developing regions--includes solving three groups of problems: overall problems (pertaining to the summary indicators of development), intersector and sectoral problems, and intraregional problems. Work on the overall problems includes establishment of optimum (from the standpoint of the entire nation) rates of development of Siberia's economy and of the optimum sectoral and regional structure of the national economy; determination of the most important intersector and national economic proportions in the economy's development and of the quantitative and qualitative indicators of the economy's efficiency; substantiation of improved methods of developing new areas so as to take into account regional peculiarities; definition of strategies for augmenting the economic and scientific-technical potential and also for raising the standard of living, and so on.

Research on economic and social problems of Siberia's economic development has a clearly pronounced practical orientation. Its results serve as the theoretical basis for drafting multiannual plans for economic development and are used by project planning, planning and scientific institutions. In addition, some of the results are submitted in the form of practical recommendations concerning prospects for development of sectors, of regional production complexes and of regions. It is very important in analyzing a region's economy to distinguish the major regional economic programs. Research is being done on the problems of such Siberian complexes as the Kansk-Achinsk fuel and power complex, the West Siberian petroleum and gas complex, the agroindustrial complex, the machinebuilding and metallurgical complex, etc.

The problems being worked on by the institute include environmental protection (in particular the improved use of the natural resources of Lake Baykal), the formation of regional production complexes, and economic development of the BAM [Baykal-Amur Mainline] zone.

Socioeconomic problems of labor resources occupy an important place in research on Siberia: peculiarities of formation of the balance of labor resources, problems concerning migration of manpower, including its demographic and economic consequences, trends and directions of the outflow of population, and the factors of migration. The institute's scientists have constructed a multiannual planned balance of Siberia's labor resources.

Indicators of the standard of living, in particular tendencies in personal consumption, as well as processes in the formation, movement and utilization of manpower, are crucial in the performance of summary national economic computations, whose task is selection of that variant which affords the best use of resources in order to maximize the level of personal consumption. The labor factor occupies a central place in the system of regional-production planning. All components of the system of models include constraints concerning labor resources and are based on supposed growth rates of labor productivity. This accounts for still another line of scientific research--economic-sociological research and development of methods of managing the formative processes, mobility and utilization of labor resources. The specific topics include the study of personnel turnover in the industrial sector, the migration of the rural population to cities, the standard of living and living conditions of Siberia's population, use of worktime and nonworking time, and the problem of applying mathematical methods in sociology.

One of the important problems is to explore ways of building permanent staffs of personnel in agriculture. Solving this problem necessitates the drafting of a comprehensive program for socioeconomic development of rural areas in the context of urbanization. Unless that kind of program is carried out, it is not possible to exert a purposive impact on migrational processes. The drafting of such a program presupposes use of the systems approach to the study of rural areas, i.e., presupposes that the rural area will be regarded as a set of interrelated spheres (components) and identification of the mechanisms whereby each of these spheres functions and also the impact which this system has on the goals of the entire system. A determination must be made of the level of manageability of the various socioeconomic processes, and specific methods of managing them must be developed. Research in this field has since 1971 been one of the leading topics in the economic-sociological group of IEiOPP projects. Among them we might single out these: development of methodological tools for socioeconomic systems research and for forecasting the processes taking place in rural areas; creation of systematized description of the present state and mechanism of the socioeconomic development of rural areas; construction of a programmed forecast of development of the country's rural areas.

Significant results obtained in this field were summarized in 1975 in the Comprehensive Program of Research on the Prospects for Socioeconomic Development of Rural Areas up to the Year 2000.

Still another direction in the institute's work is study of the economics of industrial enterprises. The institute is confronted with the problem of further development of the theory of the socialist industrial enterprise and of preparing specific recommendations on the use of mathematical-economic models to improve the planning, economic incentives and management of enterprises and production associations.

This research at the microeconomic level includes theoretical analysis of the economic activity of the socialist industrial enterprise (association) in the context of the national economy under the new conditions of planning and economic incentives, development of methods of mathematical modeling and development of a set of models of cost-accounting functioning of enterprises and intraplant planning and managing of technical-economic processes, specifically in relation to the computerization of management.[8]

The specific problems include formulation of the conditions and determination of the limits of use of the indicators of profit and profitability in assessing enterprise performance, development of the fundamental bases of material incentives in a planned economy, simulation of the cost-accounting (for example, financial) activity of the enterprise, description of the forms and types of associations and the modes of economic integration of enterprises making them up. The principal goal in the field of developing simulation models is to furnish developers of the computerized system of production management methods that make it possible to study [the impact of] various management systems or individual elements on reliability and efficiency under the specific conditions of the production and economic activity of enterprises. Research began in 1973 to analyze the management of the industrial enterprise and to shape a rational structure for it. The methods of analysis which have been developed are being used to study the interaction between the structure of physical flows and the structure of their management.

Research on Regional-Production Planning

As noted above, development of the system of mathematical-economic models of optimum multiannual regional-production planning is one of the main directions of the institute's activity. We will examine these models in individual blocs or components.

The first component is the series of models for planning, preplanning substantiations and planning computations of the rates and proportions of development of the national economy as a whole. These are the models of the dynamic intersector balance, modifications of its optimization models, models of the balance of production capacities, optimization of rates of productive accumulation in the national income, etc.[9]

Here we can name three principal theoretical results. First, a cycle of research has been completed on the problem of criteria for optimization of the national economy, a method was proposed for constructing the objective function of construction and for its use in analyzing patterns of the processes of consumption, and theorems were formulated and proven concerning the equivalents of problems with different optimality criteria (mutuality theorems). Second, a study was made of the quantitative relationships in interaction of the conditions and factors of expanded reproduction (impact of the dynamics of materials intensiveness, capital intensiveness and labor intensiveness on the rates and proportions of growth of the gross product and the national income, relationships between Departments I and II, and so on). Third, quantitative patterns characterizing the conditions of the national economy's transition to a predominantly intensive type of development were identified.

The results which are being put to the greatest use in planning practice today are those of research on a subsystem of this bloc concerned with optimization of complexes and sectoral systems governed by programs.[10] The significant basic results obtained in this field include development of a broad class of standard optimization models for planning development and location within industries (production, production-transport, multiproduct and multistage models) and methods of their mathematical-economic analysys; development of models of multisector complexes governed by specific programs (the agroindustrial complex, the lumber complex, etc.); development of the basic elements of the theory of multilevel optimization of sectoral systems (including selection of technological variants for development of primary units); and development of special mathematical methods and algorithms for solving the problems of sectoral optimization.

The next component consists of a series of regional planning models. It consists, first of all, of intersector, interregional optimization models used for determining the proportions of the national economy by union republics and regions; second, it consists of a model for optimization of the production structure of a large region; third, it consists of a group of models for optimization of the spatial structure of a region (model of the formation of regional production complexes and systems of regional production complexes); fourth, it consists of models of specific regional programs, for example, the program for economic development of the BAM zone.[11]

We might single out the following among the theoretical results: development of the principles of building spatial mathematical-economic models and of commensurization of costs and results in a regional breakdown; identification of the qualitative aspects of optimum plans of spatial organization of the economy; submittal of several basic schemes for regional planning of the national economy, including the economic mechanisms of interaction between central and regional planning agencies.

Study of the regional economy is organically related to this set of models. Research is being done from the standpoint of the regional process of reproduction, which makes it possible to regard the region's economy as a unified economic organism with specific peculiarities in its functioning and development in the various phases of the process of reproduction.[12] Retrospective intersector balances were constructed of production and distribution of the output of oblasts and economic regions, which were an important addition to regional analysis of the entire system of interrelated synthetic indicators.[13]

Development of the scientific foundations for studying the major regional problems of the national economy has great importance to devising the economic strategy for spatial development and location of the productive forces. The solving of problems of this kind is based on the specialized-program approach. For regional planning and the organization of production an economic mechanism was proposed which makes it possible to resolve the contradictions that objectively exist between the interests of each sector represented in a given region and the interests of structuring the regional economic complex in a rational way.[14]

Research related to synthesis of mathematical-economic models into an overall system has made it possible to study a number of problems which have fundamental importance to improvement of the planning and management of the national economy. For instance, theorems were formulated and proven concerning the conditions for bringing the global national economic optimum into conformity with the local optimums of the individual subsystems. It was ascertained in this connection that optimum management is impossible through the sole use of economic levers. The basic conclusion derived from mathematical study of the system of models is that economic regulatory instruments are combined in optimum planning with mandatory targets assigned with respect to a limited number of indicators.

In connection with synthesis of the system of models aims were developed for exchange of information between its blocs or components so that coordinated decisions could be taken. Methods were proposed for correlation of sectoral and regional plans. Strict mathematical results in correlating decisions were obtained for the two-level system "national economy--sector." Research has begun on the adaptive properties of economic plans.

Models which take into account social factors, the impact of scientific-technical progress, stochastic elements and the factor of indeterminacy are now being used at all levels of the system. Developments resulting from methods projects related to the system of models of optimum regional-production planning have been included in the first phase of the design of the computerized system of planning computations of USSR Gosplan.

Research on Labor Resources

IEiOPP's study of the theoretical and methodological problems of the mobility of labor resources has yielded very important scientific results which have essentially altered traditional ideas of this process. The institute's scientists have developed the foundations of an interdisciplinary economic-sociological theory of the mobility of labor resources, a theory which has pooled the results of economic research into movements of manpower and sociological research on labor mobility. The basis was established for a fundamentally new view of the mobility of labor resources which regards this as an integrated socioeconomic process of movement between points of social production and spheres of employment which on the one hand satisfies the demands of individual components of the economy for manpower of a particular field and level of skill and on the other the individual requirements of the workers which are directly or indirectly related to the jobs they hold. In the course of research broader theoretical conceptions were adopted concerning the constructive social and economic functions of the process of mobility of labor resources in development of the national economy and socialist society and also concerning the adverse consequences this process gives rise to. A system of scientific concepts describing the mobility of labor resources was substantiated: labor mobility, labor resources, the job, the unit move from one job to another, the system of jobs, the socioeconomic nature of jobs, the mechanisms of labor mobility, the work career, personnel turnover, migration of the population, horizontal and vertical labor mobility, etc. These concepts reflect the specific nature of the interdisciplinary economic-sociological study. The glossary which has been compiled of terms and concepts contains approximately 100 concepts and terms pertaining to the theory of labor mobility.[15]

Scientists of IEiOPP have developed the conception of the internal structure of the process of the mobility of labor processes, of the components which make it up and of relations between them; they have studied the connections between the real and potential mobility of personnel, migration of the population and personnel turnover, and the movement of workers within an enterprise and between enterprises; and they have studied the mechanisms of mobility of labor resources, the factors and causes giving rise to that process, and possible methods of regulating it. The effectiveness of these methods was confirmed, in particular, by a social experiment to substantially reduce turnover on the scale of a medium-sized industrial city, which was conducted in the city of Rubtsovsk (Altayskiy Kray).

The methodology and method the institute has proposed for programming sociological-economic research in the field of mobility of labor resources, including a scheme for structuring the program and specific methods of justifying each of its elements, have fundamental importance. At the same time, specialized methods of studying the movement of workers and migration of the rural population to the city have been developed and published. In the first of them, which is intended for use by plant personnel and sociological services, nearly 10 years of experience in empirical research on personnel turnover was summarized. Its peculiar feature is that turnover is not regarded as a "social evil," but as a necessary and inevitable process that performs important functions in the economy, but needs to be regulated and adjusted. By contrast with previous methods, this method includes the methodological foundations for analyzing not only real, but also potential personnel turnover not only from one plant to another, but even within the same plant.[16]

The method of sociological-statistical sampling of migration of the rural population is characterized by its viewing migration to the cities not merely as a demographic and economic process, but also as a social process, one which above all is stimulated by social differences in the conditions, level and way of life of the urban and rural population.[17]

Still another direction in the domain of labor resources research is the development, testing and use in concrete analysis of up-to-date mathematical methods of modeling and processing sociological data. IEiOPP has created a fundamentally new mathematical-economic model of migration of the population, which constitutes a system of differential equations and possesses forecasting capabilities. A modernized version of this model was developed to imitate migration of the rural population. It was proven that migration of the urban and rural populations is based on fundamentally different socioeconomic mechanisms: in cities the inflow of population comes after capital investments, in rural localities, on the other hand, the inflow of capital investments follows after the outflow of the population.

The mathematical equipment of pattern recognition was used for the first time in world sociology to study the mobility of labor resources.[18] It was used to forecast regional differences in migration of the rural population; multidimensional typologies of rural migrants to cities and also of mobile industrial workers were constructed. Methodological approaches to building systems models of the mobility of labor resources were also worked out.

Ways in Which the Results of Research Are Put to Practical Use

One of the most important principles governing the activity of the Siberian Department of the USSR Academy of Sciences is maintenance of close relations with production. The impact of Siberia's economic science on development of the economy has greatly increased over the past 20 years.

The relations between research and production are planned. The most important developments, if they have importance to application, are sent on to the USSR State Committee for Science and Technology, USSR Gosplan and RSFSR Gosplan for subsequent use in the economy. Mathematical-economic models developed in this connection must be verified against real indicators characterizing the economic development of Siberia, RSFSR or the USSR as a whole. Thus academic economic science is at the same time becoming an applied science.

Several formats are used for applying the results of basic research in production: a) submittal of materials pertaining to methods and also proposals and recommendations on solving specific problems and answering particular questions to planning, economic, project planning and scientific organizations and institutions; b) participation of the Siberian Department of the USSR Academy of Sciences in comprehensive applied research projects on the basis of contracts concerning joint efforts with enterprises and ministries; c) performance of business contracts for research work; d) assistance to enterprises, organizations and institutions in the form of scientific methods and consultation.[19]

The institute's relations with the Sibirsel'mash Plant, the Plant imeni V. P. Chkalov, which are in Novosibirsk, and the Iskitimskiy Sovkhoz have become a typical example of IEiOPP's ties with production on the basis of large programs for long-term cooperation. Research is being conducted jointly with the enterprises along two lines. The first is work on the study of the social factors of production and taking those factors into account in the management of production, and the second is improvement of production planning and the structure of enterprise management.

The results of scientific-research activity described above can on the whole be regarded as a considerable forward advance in solving a number of problems of economic science after creation within the Novosibirsk Research Center of the specialized institute of the academy, which collaborates closely with related research subdivisions. But what has been done is only one particular stage in development of this field of science in Siberia. There are many other scientific problems which need substantial work and are awaiting practical economic application.

FOOTNOTES

1. In this publication we are basically describing this institute's activity. For more detail on the history of economics research in the Siberian Department of the USSR Academy of Sciences, see: "Ekonomicheskiye issledovaniya v Novosibirskom nauchnom tsentre" [Economics Research in the Novosibirsk Research Center], Novosibirsk, 1976.

2. The conception and methodology of the systems approach to planning have been set forth in a monograph: A. G. Aganbegyan, K. A. Bagrinovskiy and A. G. Granberg, "Sistema modeley narodnokhozyaystvennogo planirovaniya" [System of National Economic Planning Models], Moscow, 1972.

3. See, for example, "Optimal'noye territorial'no-priozvodstvennoye planirovaniye" [Optimum Regional-Production Planning], Novosibirsk, 1969; "Problemy narodnokhozyaystvennogo optimuma" [Problems of the National Economic Optimum], Moscow, 1969; "Problemy narodnokhozyaystvennogo optimuma," Novosibirsk, 1973; N. F. Shatilov, "Analiz zavisimostey sotsialisticheskogo rasshirennogo vosproizvodstva i opyt yego modelirovaniya" [Analysis of the Functions of Socialist Expanded Reproduction and Experience in Building Models of It], Novosibirsk, 1974.

4. See A. G. Granberg, "Optimizatsiya territorial'nykh proportsiy narodnogo khozyaystva" [Optimization of the Regional Proportions of the National Economy], Moscow, 1973.

5. See M. Ya. Lemeshev and A. I. Panchenko, "Kompleksnyye programmy v planirovanii naordnogo khozyaystva" [Comprehensive Programs in National Economic Planning], Moscow, 1973.

6. See "Ekonomicheskiye problemy razvitiya Sibiri" [Economic Problems in Siberia's Development], Novosibirsk, 1974.

7. IEiOPP is a support organization of the Scientific Council of the USSR Academy of Sciences for Problems of the Baykal-Amur Trunk Rail Line.

8. See, for example, R. G. Karagedov, "Rentabel'nost' i effektivnost' sotsialisticheskogo predpriyatiya" [Profitability and Efficiency of the Socialist Enterprise], Novosibirsk, 1971.

9. They were used in the preliminary stages of drafting the 9th and 10th 5-year plans and the long-range forecast covering the 1976-1990 period. The model of the intersector dynamic balance was sent on to the State Planning Agency of the GDR. A series of models has been built for forecasting the economic development of the United States, West Germany, Japan and other capitalist countries.

10. A number of developments resulting from methods projects have been sent to Soviet ministries and departments; the following have been published: "Metodicheskiye polozheniya optimal'nogo otraslevogo planirovaniya v promyshlennosti" [Methods Principles for Optimum Planning at the Industry Level in the Industrial Sector], Novosibirsk, 1972; "Osnovnyye polozheniya optimizatsii razvitiya i razmeshcheniya proizvodstva" [Basic Principles for Optimizing Development and Location of Production], Moscow-Novosibirsk, 1969. The "Standard Method of Computations Concerning Future Development and Location of Production Using Mathematical-Economic Models" was prepared jointly with TsEMI of the USSR Academy of Sciences and the Council for the Study of the Productive Forces of USSR Gosplan and submitted to USSR Gosplan.

11. These models have already gone through experimental verification. The "Methods Principles of Optimizing the Spatial Structure of an Economic Region" have already been published (Novosibirsk, 1975). The results of optimizing formation of regional production complexes are being used by USSR Gosstroy in working out regional layout charts.

12. See R. I. Shniper, "Svodnoye planirovaniye narodnogo khozyaystva oblasti i rayona" [Summary Economic Planning of the Oblast and Rayon], Moscow, 1972.

13. See "Analiz mezhotraslevykh svyazey Sibiri i Dal'nego Vostoka" [Analysis of Intersector Relations of Siberia and the Far East], Parts 1, 2, Novosibirsk, 1972.

14. See, for example, B. P. Orlov and R. I. Shniper, "Ekonomicheskaya reforma i territorial'noye planirovaniye" [The Economic Reform and Regional Planning], Moscow, 1969.

15. See "Metodologicheskiye voprosy izucheniya sotsial'nykh protsessov" [Methodological Problems in Studying Social Processes], Novosibirsk, 1974; "Metodologicheskiye problemy sotsiologicheskogo issledovaniya mobil'nosti trudovykh resursov" [Methodological Problems of Sociological Study of the Mobility of Labor Resources], Novosibirsk, 1974.

16. See "Opyt issledovaniya peremeny truda v promyshlennosti" [Experience in Studying Job Changes in the Industrial Sector], Novosibirsk, 1969; "Dvizheniye rabochikh kadrov na promyshlennykh predpriyatiyakh (teoreticheskiye i metodologicheskiye voprosy analiza tekuchesti)"

[Movement of Workers at Industrial Enterprises (Theoretical and Methodological Problems in Analysis of Turnover)], Moscow, 1974.

17. See "Metodoka vyborochnogo obsledovaniya migratsii sel'skogo naseleniya" [Method of a Sample Survey of Migration of Rural Population], Novosibirsk, 1969.

18. See "Raspoznavaniye obrazov v sotsial'nykh issledovaniyakh" [Pattern Recognition in Social Research], Novosibirsk, 1968.

19. We might mention as specific examples the "Method of Drafting Multiannual Plans of Development, Specialization and Location of Production in the Electrical Equipment Industry," which was awarded a medal of the Exhibition of Achievements of the USSR National Economy, and methods principles of optimum planning at the level of the sector or industry.

    Approximately 80 specific problems have been solved on the basis of the methods principles which IEiOPP has developed under assignments from planning, sectoral and project planning organizations. The results of computations have been used to prepare variants of plans for development of sectors and industries in the periods 1966-1970, 1971-1975, 1976-1980 and the period up to the year 1990.

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NORMS FOR SETTING UP SINGLE SCIENCE, TECHNOLOGY DEVELOPMENT FUND

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[Article by Ya. Lyubinetskiy, deputy director of Informelektro, and V. Shalimov, candidate of economic sciences: "Norms for the Formation of a Single Fund for the Development of Science and Technology"]

[Text] The decree of the CPSU Central Committee and USSR Council of Ministers entitled "Improving Planning and Strengthening the Influence of the Economic Mechanism on Raising Production Efficiency and Work Quality" envisions the establishment of a single fund for the development of science and technology at ministries and departments to step up scientific-technical progress and broaden the production of new, highly efficient products. In conformity with the decree, "Methodological Instructions on Formation and Use of the Single Fund for the Development of Science and Technology" were worked out and, on 11 September 1979, ratified.

This document reflects the experience of the sectors in financing scientific research, experimental design, and production engineering work, recovering expenditures for the incorporation of new types of output, and financing measures to improve product quality. An analytic evaluation of experience with the use of this fund that has been accumulated in a number of industrial sectors and development of proposals to refine and elaborate these practices are very timely.

Determination of the Size of the Single Fund for the Development of Science and Technology at the Sector Level

The above-mentioned methodological instructions on formation and use of the SFDST [single fund for the development of science and technology] stipulates that the single fund is formed out of deductions from the planned profit of science-production and production associations (enterprises) and organizations according to a norm established for the ministry (department) in the USSR State Plan of Economic and Social

Development (with a breakdown by years) as a percentage of net (normative) output, and of commodity output in certain sectors.

It is plainly expedient to identify two stages in the process of development of a specific methodology for determining the economically substantiated size of an SFDST at the sector level. In the first stage formation of the fund must be tied to movement of a base index that is more stable than profit or volume of output sold and with prospective changes in expenditures for measures related to science and technology in the sector. In the second stage, which requires some preparatory work, formation of the SFDST must rely on a normative analytic technique that permits a well-founded determination of the amount of capital to be spent for the development of science and technology.

The index used as a base for calculations should be one whose numerical values are not subject to strong influence by external factors, as changes in profit or sale of output are.

The need to use fairly stable base indexes in formation of the SFDRT is emphasized in the above-mentioned decree of the CPSU Central Committee and USSR Council of Ministers, which stipulates that the amount of deductions to the single fund will be established as a percentage of net (normative) output, and of commodity output in certain sectors. The work experience of the sectors confirms that the indexes of profit and sales are not effective enough to perform the functions of base indexes for the formation of the SFDST. The Ministry of Electrical Equipment Industry was the only one to use the profit index in this way. But since 1979 this sector too has begun determining the norm of deductions from profit to the SFDST as a percentage of the planned volume of production of commodity output. The Ministry of Heavy and Transport Machine Building and the Ministry of Tractor and Agricultural Machine Building substituted the planned volume of production (based on normative net and commodity output) for the index of sales beginning with the second half of 1977.

It is not correct, however, to tie the size of the SFDST to change in the volume of commodity output alone, because one of the general rules of scientific-technical progress is its fast pace, exceeding the development of industrial production. Therefore, the size of the SFDST must surpass the base index, that is, volume of commodity output. This point in formation of the SFDST may be accomplished by coefficients of the ratio of average annual growth rates of the SFDST and net (commodity) output for the five-year period preceding the planning period. The stable character of a dynamic series of these coefficients makes it possible to adopt their average value (calculated by average annual growth rates) as the primary factor that determines growth in the SFDST by years of the five-year plan or for the longer run.

Thus, the planned sum of deductions to the SFDST of an industrial sector for a five-year period ($E_{\text{ф.т}}$) is found by the following formula

$$E_{\Phi.\text{п}} = E_{\Phi.\text{б}}\left(1 + \frac{T_\text{п} K_\text{о}}{100}\right), \qquad (1)$$

where $E_{\Phi.6}$ is the actual size of the SFDST in the base period (the year preceding the five-year period being planned); T_π is the rate of growth of volume of net (commodity) output in the planning period calculated as a running total from the start of the five-year period; K_o is the ratio of the average annual growth rates of the SFDST and net (commodity) output during the five-year period preceding the five-year period being planned ($K_o > 1$ is assumed in the calculation).

Thus, the planned size of the SFDST of a sector is composed of its actual size in the base period ($E_{\Phi.6}$) and growth ($\Delta E_{\Phi.6}$), which is determined by the expression

$$\Delta E_{\Phi.\text{б}} = E_{\Phi.\text{б}} \frac{T_\text{п} K_\text{о}}{100}.$$

The coefficient of the ratio of the SFDST and growth in production volume (K_o), for example for the electrical equipment industry during the current five-year plan, may be established at 1.24 following the appropriate calculations.

To take account of the effect of change in the scale of work related to scientific-technical progress in the industrial sectors the size of the planned SFDST determined by formula (1) must be corrected with due regard for the volume of development and introduction of new technology. Its size should be increased or decreased depending on the length of the replacement cycle for the primary part of output or the proportion of new technology in the total volume of production by introducing correction coefficient K_π. The final formula for determining the planned size of the SFDST in an industrial sector thus assumes the following form:

$$E_{\Phi.\text{п}} = E_{\Phi.\text{б}}\left(1 + \frac{T_\text{п} K_\text{о}}{100}\right) K_\text{п}. \qquad (2)$$

The concrete value of the coefficient K_π may be determined to lie between 0.8 and 1.25 for the electrical equipment industry. $K_\pi = 1$ is the average value of the replacement rate of output (the proportion of new output in total production volume) for the group of machine building and metalworking sectors. The scale of values presented in Table 1 for the correction coefficient is proposed on the basis of calculations made for this sector for the current five-year plan.

The growth rate of the SFDST cannot exceed the growth rate of balance profit of an industrial sector. The size of the fund is determined according to formulas (1) and (2) and is envisioned in absolute terms in the financial plan for the five-year period with a breakdown by years.

Table 1

Replacement Rate of Output, years	Percentage of New Equipment in Total Production Volume	Correction Coefficient of Planned Size of SFDST
12 and more	8.34	0.80
11	9.1	0.85
10	10.1	0.90
9	11.1	0.95
8	12.5	1.00
7	14.3	1.10
5 an 6	16.7	1.20
5 and less	20.0	1.25

The technique being proposed by the authors will make it possible to give the norms for deductions from profit the necessary stability, and it will make changes in the corresponding amounts dependent to some degree on renewal of output being produced. At the same time, this technique does have shortcomings and contradictions.

The calculation of the planned size of the SFDST is found at above all on the base (established) amount of capital. Two alternatives for calculating this base figure are possible. One of them is where the planned size of the SFDST is determined in the first year of its operation. In this case the total of the corresponding capital in the state budget, the fund for scientific research projects, and the fund for incorporation of new equipment in the year preceding the planning period serves generally as the base. However, experience shows that the level of this capital usually does not meet the true need of the sector for resources to carry out steps to accelerate scientific-technical progress.

The second variation of the calculation takes place when determining the amount of the SFDST in planning year t. In this case the actual (planned) size of the SFDST in the year preceding the planning period is taken as the base. The increment (change) in capital occurs as the base index of SFDST formation (planned profit, volume of output, and the like) grows. Naturally, this kind of change in initial capital will not bring it close to the amount of the sector's real need for resources.

Thus, the alternatives considered for the starting point for calculating the amount of the SFDST only roughly characterize the sector's true need for capital during the year (period) preceding the planning period.

After determining the base size of the SFDST it is necessary to find the growth in this amount, which depends on the rate of growth of the volume of net (commodity) output and an empirical coefficient that expresses the ratio of the growth rate of the SFDST and net (commodity) output. However, the movement of capital designated for financing scientific-technical progress is only indirectly linked to the growth rate of volume of net (commodity) output corrected by the empirical coefficient (K_o). This problem can be partially eliminated by introducing correction coefficient K_π, which reflects the level of replacement of output being produced.

The second stage in refining the formation of the SFDST of an industrial sector is application of the normative analytic technique. The necessary amount of money in the SFDST should be calculated on the basis of analytic norms that encompass the entire process from research to production. The following schematic diagram is proposed for their formation.

The final national economic results of the work of scientific research and design organizations are the development and building of new means and objects of labor and technological processes. The magnitude of expenditures for the entire cycle from research to production is determined proportional to the final results. Expenditures to incorporate the initial period of series production (in the first year, and where necessary in the second year) are determined initially from the planned volume of new capital and objects of labor subject to introduction. This amount is influenced by change in the prime cost of the corresponding group or series of articles. Establishing substantiated norms for expenditures for incorporation of the initial period of series production requires complex analytic calculations and a strict description (formalization) of the movement of the corresponding costs.

Next expenditures to prepare for the production of new equipment, which encompasses a stable list of jobs, are established. This makes possible working out substantiated expenditure norms in the particular stage of the process from research to production. Finally, expenditures for scientific research and experimental design work are calculated. It is advisable to make norms for these expenditures proportional to the costs of preparation for and incorporation of production. It is obviously necessary to find the ratio between exploratory research for the purpose of creating a scientific backlog in the sector and applied development work. Experience shows that establishing direct norms of expenditures for scientific research and experimental design work in the particular stage of the overall process from research to production is very questionable.

The economically substantiated size of the planned SFDST is shaped on the basis of the basic expenditure norms considered for stages of the cycle from research to production. Expenditures for other jobs (for example, work related to economically sound improvements in quality, reliability, and longevity of articles incorporated earlier) to be financed from the SFDST are envisioned proportional to these basic norms, which should be sector-wide, long-term, and stable norms.

Norms for Deductions to the SFDST at the Association and Enterprise Level

The degree of participation by each element of an industrial sector in the formation of the SFDST depends on economic conditions (amount of profit) and the scope of activities related to scientific-technical development. In our opinion, therefore, it is incorrect to differentiate formation of the single fund by the use of capital at enterprises and associations. This will lead to a situation where the formation of the fund and, accordingly, acceleration of scientific-technical progress in the sector will be the individual concern of each subdivision.

Theoretically, it would be economically sound for the ministry to establish stable, uniform norms for deductions from profit to the SFDST for subsectors. At the level of large autonomously financed complexes (all-Union production associations) the economic conditions of work and scope of activities related to scientific-technical development should be evened out. This makes it essential to give the all-Union production associations equal opportunities for financial support. In practice, however, the economic conditions and work results (amount of profit and profitability) of the all-Union production associations differ significantly, as is also true of production associations and enterprises. This is why there should be a substantiated differentiation of norms for deductions from profit to the SFDST at all levels of the sectorial system.

The methodological instructions on formation and use of the SFDST stipulate that, where necessary, the ministry (department) may differentiate the sizes of deductions to this fund for particular associations and enterprises within the limits of the total amount ratified for deduction to the single fund. Such differentiation certainly should consider, on the one hand, the economic conditions and work results of the corresponding element which are expressed in the indexes of profit and profitability and, on the other hand, the volume and scale of work related to scientific-technical development, which may be characterized, for example, by the proportion of output with the State Mark of Quality. However, simultaneous consideration of these different factors is a complex problem. It is clear that the differentiation of deduction norms from profit to the SFDST for all-Union production associations, production associations, and enterprises should take into account one of the factors depending on its significance for the entire sector.

For example, let us consider the economic conditions and work results of an element of the sectorial system. This factor can be taken into account by establishing the amount of deductions to the SFDST directly proportional to the subsector's share of the total volume of profit of the sector. But the same amount of profit in different subsectors is not usually the result of equally efficient work. With electrical equipment, for example, wholesale prices are set at 9-18 percent of the prime cost of the corresponding groups of articles according to differentiated profitability norms for output. Of course, where other conditions of resource use are equal and growth in production volume is the same, the growth in profit will be more significant for a subsector that has a higher profitability norm.

It is obviously wise to use a norm for deductions by share of profit of an all-Union production association in sectorial profit corrected by a coefficient that takes account of the planned profitability of output. To determine this coefficient 13 subsectors of the electrical equipment industry were put into three groups by level of profitability (see Table 2).

Table 2

Group of Subsectors	Profitability Range, %	Coefficient of Profitability Difference Determined by Extreme Values of Profitability
I	22.2-25.2	1.2 (25.2:21.0)
II	14.0-21.0	1.0
III	6.8-13.3	0.63 (13.3:21.0)

As can be seen from Table 2, the coefficient of profitability difference, which is the ratio of the extreme values of groups I and III to the extreme value of group II was 1.20 for group I and 0.63 for group III. The values of these coefficients by average levels of profitability are 1.25 for group I and 0.67 for group III. However, considering that groups I and III were the same for share of sector profit, it seems advisable to employ an equal degree of decrease (increase) in the coefficient for deviation from the average level (that is, from the value of group II, which is taken to be 1). Considering this correction, the coefficient of profitability difference K_p for calculating the sums of deductions to the SFDST is 1.20 for group I and 0.80 for group III. This procedure for determining the share of deductions from the profit of a subsection to the SFDST may be written in the form of the following formula

$$Д = \frac{П_{в} K_{р}}{П_{о}} 100\,\% . \qquad (3)$$

where $Д$ is the share of deductions from subsector profit to the SFDST as a percentage of the total amount in the single fund of the sector;

Π_{π} and Π_{o} are the balance profit of the subsector and sector, respectively.

Calculations made on the basis of formula (3) give the economically substantiated amount of deductions from profit to the SFDST for each subsector of the electrical equipment industry (see Table 3, next page). In this case the share of deductions from subsector profits to the single fund of the sector differs significantly from the actual distribution of these deductions which occurred under the influence of random factors.

The results of the calculations presented in Table 3 apply to subsectors (all-Union production associations) of the electrical equipment industry. However, the proposed methodology for determining norms of deductions from profits to the SFDST on the basis of formula (3) is entirely applicable to other industrial sectors.

Differentiation of deduction norms from profit to the SFDST depending on the scale of activities related to scientific-technical development may take various forms, for example reflecting the proportion of output in the highest quality category (with the State Mark of Quality). In sectors where the percentage of such output is low no deductions to the SFDST are made (from profits realized as the result of selling this output). In other sectors deductions to the single fund from profit obtained by selling output with the State Mark of Quality are made in smaller amounts than deductions from other profit. Finally, there may be a progressive decrease or increase in deductions to the SFDST for all-Union production associations (enterprises) which have a higher (lower) share of output with the State Mark of Quality than the average for the sector (all-Union production associations).

The use of norms structured in this way will make it possible to give all-Union production associations and enterprises that are turning out new, high-quality output favorable conditions and to form the single fund chiefly at the expense of associations and enterprises producing products incorporated earlier (first and second quality categories). This procedure for formation of the SFDST will, on the one hand, be more stable, while on the other hand it provides an additional stimulus to update output. The advantage of the proposed technique is that it creates a additional economic conditions for achieving an economic accountability impact because the payments from profit will be lower for enterprises that are uptdating their output more aggressively.

At the present time the SFDST is entirely centralized at the level of the industrial sector (ministry). The CPSU Central Committee and USSR Council of Ministers decree "Improving Planning ans Strengthening the Influence of the Economic Mechanism on Raising Production Efficiency and Work Quality" envisions, in a timely and well-founded manner, authorizing industrial ministries to put part of the capital in the SFDST at the disposal of all-Union (republic) industrial associations and large

Table (in %)

(a) Подотрасль (производство)	(b) Удельный вес отчислений подотраслей в формировании отраслевого ЕФРНТ		Отклонение расчетных значений от фактических, гр.3:гр.2 (превышение +, уменьшение –) (e)	Распределение использованных средств ЕФРНТ по подотрасли в среднем за 1969—1977 гг. (f)	Величина средств ЕФРНТ, оставляемых в распоряжении подотраслей по предлагаемой методике (g)
	фактически в среднем за 1969—1977 гг. (c)	по предлагаемой методике (d)			
1	2	3	4	5	6
(h) Тяжелое электромашиностроение	1,3	4,7	3,6 раза*	6,2	3,6
(i) Производство электродвигателей малой и средней мощности	3,1	6,2	2,0 раза*	6,9	2,0
(j) Производство микроэлектродвигателей и аппаратуры к ним	2,1	5,4	2,6 раза*	4,6	2,3
(k) Трансформаторостроение и производство высоковольтной аппаратуры	8,5	9,6	+13	5,1	5,1
(l) Низковольтное аппаратостроение	11,6	14,6	+26	6,5	5,0
(m) Транспортное электромашиностроение	7,3	6,2	–16	6,7	3,2
(n) Кабельная промышленность	16,0	11,3	–30	3,3	2,6
(o) Электроизоляционная промышленность	7,0	4,4	–37	1,9	1,1
(p) Производство электротермического и сварочного оборудования	6,4	7,4	+15	3,2	4,4
(q) Производство преобразовательной техники и электропривода	4,5	4,2	–17	7,7	3,2
(r) Производство электроисточников тока	6,4	6,1	– 5	9,1	3,1
(s) Производство источников света и светотехнического оборудования	21,1	17,0	–15	3,7	10,3
(t) Прочие	0,7	0,2	2,5 раза*	34,8	0,2
(u) Электроремонт	4,0	2,7	–32,5	0,3	-
(v) Всего по отрасли	100	100	—	100,0	46,1

*[Russian word means "times," i.e. "3.6 times" and etc.]

Key:
- (a) Subsector (production);
- (b) Share of Deductions of Subsectors to Formation of Sectorial SFDST;
- (c) Actual Average for 1969-1977;
- (d) According to Proposed Methodology;
- (e) Deviation of Calculated Values from Actual, group III: group II;
- (f) Distribution of SFDST Capital Used by Subsectors, average for 1969-1977;
- (g) Amount of SFDST Capital Left at Disposal of Subsectors According to Proposed Methodology;

[Table continued next page]

[Table 3 continued]

(h) Heavy Electrical Machine Building;
(i) Production of Small and Medium Electric Motors;
(j) Production of Microelectric Motors and Apparatus for Them;
(k) Production of Transformers and High-Voltage Equipment;
(l) Low-Voltage Equipment Manufacture;
(m) Electrical Transport Machine Building;
(n) Cable Industry;
(o) Electrical Insulation Industry;
(p) Production of Electrothermal and Welding Equipment;
(q) Production of Convertor Equipment and Electric Drive Gear;
(r) Production of Sources of Electric Current;
(s) Production of Sources of Light and Light Engineering Equipment;
(t) Other;
(u) Electrical Repair;
(v) Total for the Sector.

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production and science-production associations. Experience shows that in order to achieve efficient use of SFDST capital, concentration of the bulk of resources on incorporation of new technology (compensation for increased expenditures in the initial period of series production), and creation of an incentive for economical use of capital at the level of the medium and primary elements of the sector, it is wise to accumulate a certain part of enterprise deductions from profit to the SFDST in special all-Union production association accounts and to centralize part at the sector level.

Based on analytic evaluation of the actual ratio of projects related to scientific-technical progress performed in the electrical equipment industry in 1969-1977, 20-60 percent of the deductions from enterprise profit to the sectorial SFDST may be left at the disposal of the all-Union production associations. However, the share of deductions from enterprise profit to the SFDST left for these associations should be economically substantiated and determined on the basis of norms. The sum of SFDST capital left at the disposal of the all-Union production association is closely tied to the volume of work related to scientific-technical development because the norms are based on the index of proportion of new equipment in the total production volume of the corresponding subsector.

To determine the differentiated norms for formation of subsector SFDST's (the shares of the sectorial SFDST left at their disposal) depending on the proportion of new equipment the scale shown in Table 4, based on the principle of arithmetic progression (regression), is recommended. The scale takes account of the range (2-21 percent) in proportion of new equipment. The number of terms of the arithmetic regression n = 11; the number of terms of the arithmetic progression n = 10.

Table 4

Деся-тые доли (b)	(a) Удельный вес новой техники в общем объеме производства, %						
	21	...	13	12	11	...	2
	(c) Значения нормативов формирования ЕФРНТ подотраслей, %						
0	77,0	...	53,0	50,0	47,0	...	20,0
1	77,3	...	53,3	50,3	47,3	...	20,3
2	77,6	...	53,6	50,6	47,6	...	20,6
3	77,9	...	53,9	50,9	47,9	...	20,9
4	78,2	...	54,2	51,2	48,2	...	21,2
5	78,5	...	54,5	51,5	48,5	...	21,5
6	78,8	...	54,8	51,8	48,8	...	21,8
7	79,1	...	55,1	52,1	49,1	...	22,1
8	79,4	...	55,4	52,4	49,4	...	22,4
9	79,7	...	55,7	52,7	49,7	...	22,7
	(d) Номера членов						
	прогрессии (e)				(f) регрессии		
	10	...	2	1	2	...	11

Key:
- (a) Percentage of New Equipment in Total Production Volume;
- (b) Tenths;
- (c) Values of Norms for Formation of Subsector SFDST, percentage;
- (d) Number of Terms;
- (e) Of Progression;
- (f) Of Regression.

When calculating this scale the difference of the progression (regression) was taken as three percentage points (d = 3). This quantity was practically determined on the basis of the optimal volume of production of new equipment, which refers to high-quality output manufactured for the first time during the first three years of production. Each percentage point of new equipment corresponds to three percent of the deductions from profit to the SFDST.

The first member of the progression (a_1) is taken as the average norm (h_e^o = 50 percent), corresponding to the average level of new equipment in the total volume of net (commodity) output of the electrical equipment industry, which is 12.2 percent. Every term of the progression, whole number or fraction, is determined by the formula

$$a_n = a_1 + d(n-1). \qquad (4)$$

Members of the progression from the first to the tenth correspond to proportions of new equipment in total subsector production volume from 12 to 21 percent.

Any member of the regression, whole number or fraction, is determined according to the formula $a_n = a_1 - d(n - 1)$. (5)

The members of the regression from the first to the eleventh represent proportions of new equipment in total subsector production volume from 12 to two percent.

The values of norms for formation of subsector SFDST's are given as percentages of the total of deductions from the profit of the corresponding all-Union production association which must be used to form the single fund. Let us give an example of the use of the proposed scale.

In the subsector that produces transformers and high-voltage apparatus, for example, the planned proportion of new equipment in total production volume is 13.2 percent. According to the scale the norm for formation of the SFDST remaining at the disposal of this subsector will be 53.6 percent of the planned deductions from profit to the single fund (see Table 4). Accordingly, 46.4 percent (100-53.6) of the planned subsector deduction will be centralized at the ministry level. The amount of SFDST capital suggested to remain at the disposal of the subsector corresponds with the actual level of capital received from the SFDST (see line 4, columns 5 and 6 of Table 3).

The calculations made for the 12 subsectors of the electrical equipment industry on the basis of 1977 plan indexes show that 46.1 percent of the planned deduction to the SFDST can remain at the disposal of the subsectors while the remainder must be centralized at the ministry level. The money left at the disposal of the subsector cannot exceed planned deductions from profit to the single fund. The amount of SFDST capital calculated by the proposed methodology and left at the disposal of the subsectors can only be greater than the total capital actually received from the SFDST in two cases: at enterprises that produce electrothermal and electrical welding equipment and enterprises that produce light engineering equipment and electric light bulbs. It appears that the amount of appropriations now given to these subsectors from the SFDST is inadequate. With a large percentage of new equipment (15 and 15.5 percent respectively) in the total volume of production of these subsectors, they have received only five and 3.8 percent of sector capital allocated to compensate for expenditures related to incorporation and production preparation and increased expenditures for production preparation and incorporation of new equipment.

The proposed method of forming and using the SFDST makes it possible to eliminate existing shortcomings in the distribution of SFDST capital among different management objects and to bolster their economic interest in expanding the incorporation and production of new equipment. Subsectors will use the decentralized SFDST capital in a more operational, efficient manner, directing it to appropriate projects related to new equipment. Examples of such projects might be steps to increase the technical level and quality of output which do not involve price changes for these products or compensation for increased expenditures to incorporate serious production. The centralized part of the SFDST should be distributed by the sector management among the industrial enterprises that are introducing and incorporating new equipment most aggressively and experiencing shortages of their own capital. In addition, this part of the fund should be used to solve problems of scientific-technical progress that are of general sectorial or intersectorial importance.

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NEW ASPECT OF SPACE USE DISCUSSED

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[Article by B. Borovskikh, Docent, Candidate of Economic Sciences: "New Aspect of the Space Structure of the Use of Nature"]

[Text] At the 25th CPSU Congress it was noted that the face of individual regions of the country, to a greater and greater degree, will be determined by the carrying out of large-scale national-economic programs and by the creation of territorial-production complexes (TPK)[1]. Thus, in addition to the branch and regional proportions, regional-production proportions are forming. The further development of the division of social labor under conditions of the NTR [scientific-technical revolution] is leading to a situation in which vertical-zonal proportions in the national economy also arise. These are a variety of spatial proportions and, in the aggregate with territorial proportions, reflect the spatial structure of production.

The development of production, as is well known, presupposes the existence of the corresponding spatial base. "If a certain degree of development of the productive force is given," K. Marx pointed out, "then a definite amount of space is always needed"[2]. Until recently, the concept of "spatial base" was associated with the concept of "territory." Yet, the limited nature of the territorial resources, and their intension involvement in economic turnover[3] have been necessitating, to a greater and greater degree, the assimilation of space along the vertical. The "pellicular," "two-dimensional" placement of productive forces no longer corresponds to the demands for their further develop and, to a greater and greater extent, is supplemented by the volumetric, "spatially three-dimensional" placement.

The "Raumization"[4] of placement manifests itself in the assimilation both of space above the earth and below the earth. The involvement of the space above the earth in circulation acts first of all in the form of multistory construction. For example, the share of newly activated housing in buildings with an increased number of stories (6 or more) increased in our country from 2 percent in 1963 to 25.2 percent in 1973. Apartment buildings with 12 or more stories, which, practically speaking, were not built before 1963, constituted 4.2 percent in 1973. In Moscow in 1977, buildings consisting of 10-15 stories or more accounted for 22.0 percent of the total housing fund, whereas in 1966 they constituted 4.3 percent[5]. A similar tendency is observed in other countries as well[6]. The increase in the number of stories in housing, industrial, and transport (the construction of transport scaffoldings, etc.) construction has been influenced not only by the limitation of the territories, but also by the interests of protecting the environment (for example, the construction of smokestacks 150-320 meters high, or even higher), by the creation of of comfortable living conditions, etc.

The increase in the horizontal level of placement of national-economic activity, the growing involvement in circulation of the space that is close to the earth, manifest themselves with particular clarity in the development of aviation and space travel. For example, whereas in 1940 the share of air transport in the country's passenger turnover was less than 0.2 percent and in 1965 slightly more than one percent, in 1978 that share was approximately 16 percent[7]. The same tendency has been observed in freight shipments. There has been an increase in aviation's role in agriculture, forest management, fishing, and geological prospecting.

A new phenomenon in the mastery of inner space is the application of space flights: the search for and study of the earth's natural resources, the forecasting of the weather and incipient calamities, the carrying out of radiotelephone communication and television broadcasts. In the future it is planned to put out into space several "earth-type" production entities and to create new space production entities, and to form artificial power-engineering extraterrestrial complexes.

Cosmonautics is already yielding a tangible national-economic effect. For example, the profitability of long-distance television broadcasts with the aid of satellites of the Molniya type is 2-3 times greater than the construction of radio-relay lines for the same purposes. The use of space equipment in geological prospecting annually yields a saving of as much as 170 million rubles. The total economic benefit from the use of space technology in the national economy in 1976-1990, according to forecasts, will be 10 billion rubles a year. According to preliminary data provided by American specialists, the capability of precise forecasting of the weather with the aid of space equipment for at least a three-day period provides an economic benefit on a worldwide scale of $60 billion a year[8].

Multistory construction, the assimilation of air space and outer space, are only a part of the "vertical problem." A second aspect of the problem is the assimilation of the resources in the bowels of the earth. And whereas space above the earth is being successfully assimilated with the aid of air and space technology, the penetration into the depths of the earth, by virtue of the tremendous technical difficulties, has been possible for only a few kilometers.

The assimilation of the depths of the earth is developing at the most rapid rates in the form of subterranean urbanistics: the construction of transportation and other subterranean communications lines (subways, motor roads, pedestrian walkways, etc.), and construction projects designed for industrial, warehouse, everyday, and social-cultural purposes. In recent years the space under the earth has been involved in circulation to a greater and greater degree as a natural storage capacity for the storage of natural gas, the pumping in of contaminated runoffs, the storage of solid production waste, etc.

However, the resolution of the vertical problem is associated primarily with the involvement of the mineral wealth contained in the bowels of the earth, the development of which mineral wealth assures, practically speaking, the complete satisfying of the needs for mineral raw materials, and the overwhelming part of the power resources and construction materials that are needed by mankind.

The clearly traced tendency toward shifting the development of mineral resources to deeper levels (as a result of the exhaustion of the upper levels, the increase in the need for mineral raw materials and fuel, the introduction of scientific-technical achievements into mining, etc.) leads to a complication of the ecological conditions: the amounts of land removed are expanded, the landscape is changed, and there is an increase in the amount of pollution of the environment. The labor conditions of the miners also are becoming more complicated and less favorable: there has been an increase in the burden, the degree of harmfulness, the threat of accidents, etc. The problem of the "vertical" in the mastery of natural resources pertains also to the ocean depths. Deeper and deeper levels of the World Ocean are being involved in economic turnover. In addition to the use of biological resources that are located, for the most part, in direct proximity to the shore line and the surface of the water, there has been an increase in the scale and rates of extraction of mineral wealth from the ocean bottom (petroleum, gas, iron and manganese ores, etc.).

From what has been stated, there follows the conclusion that during the era of the NTR, the development of productive forces has a natural underlying law of spatial expansion not only along the horizontal, but also along the vertical. The "pellicular" placement of production forces which was typical of previous development is being supplemented, to a greater and greater degree, by volumetric, spatially three-dimensional placement. In addition to the formation of territorial-production complexes, and economic regions, thus, one sees in the placement of production the formation of a vertical zonality of production activity.

What serves as the natural basis here is the ecological nonhomogeneity: for example, within the confines of a 20-kilometer vertical line -- from the highest point on the earth to the deepest depression in the World Ocean -- one can detect a number of "tiers," which differ substantially with regard to their ecological data. Each one of them is typified by its own resources (organic, mineral, reproducible and nonreproducible), its own nature of ecological interrelationships, the specific content of the production activity, different intensity of the interaction between man and the environment. That system expanded spatially along the vertical from several hundred meters in the past century to hundreds and thousands of kilometers at the present time. The degree of the ecological differences increases in proportion to the involvement of the air basin, space, the ocean bottom, etc. in the bio-economic system. Linked with the nonhomogeneity of the ecological conditions and resources along the verical are the vertical distribution of social labor, the forms of its organization, system of payment, etc. All this also leaves its imprint upon the final results of the management, its technical-economic indices, and the ecological consequences.

For example, the development of the mineral resources by the open method, with comparatively shallow depths of cutting, is fraught with relatively large violations of the landscape and the soils, and the more intensive pollution of the atmosphere with mine methane that the extraction by the mine method is. There are dissimilar ecological consequences from the exploitation of petroleum and gas deposits that are situated on the land and under the water. The noise levels from ground, underwater, and air engines are different, etc.

A natural law underlying the change in the vertical structure of production is the reduction of the share of the social labor directly on the surface of the earth and the water, and the increase in the percentage of expenditures in the bowels of the earth, the ocean depths, and in air and outer space. In this regard there arises the question of the spatial limits of the vertical zones as one of the conditions for the formation of the vertical proportions.

It is well known that the planning of the proportions of production first of all presupposes the distribution of its material-substantial factors: manpower, and objects and means of labor. Under the effect of technical progress, there occurs a spatial separation of the personal factor from the material ones. Thus, when exploiting quarries of building materials with the aid of machinery, the worker is separated from the object of labor by only a few meters; when drilling wells for petroleum and gas, by kilometers; when controlling power units with the aid of means of telemechanics, by tens of kilometers; and when regulating from the earth the flights of spacecraft, by thousands or even millions of kilometers. Also, the vector of the vertical for technical-economic indices, as a rule, is much weightier, much "denser" than the territorial vector. The shifting of production upward or downward along the vertical from the "pellicular" zone is accompanied in most instances by a considerably greater differentiation of the expenditures and results as compared with a change of displacement according to territory. For example, when establishing labor norms for loaders, one meter of vertical displacement of cargo is equal to 10 meters of horizontal. The difference in the payment of labor in operations above the ground and below the ground, which are separated by tens or hundreds of meters, is more tangible as compared with the differences in payment by regions that are separated by hundreds or even thousands of kilometers. In order to haul one ton of freight 100 kilometers by truck, it takes approximately 10 kilograms of fuel, and by airplane, tens of times more. When determining the spatial limits of the vertical proportions, there arises the question: should one consider this limit to be the entire length of the technological chain in the process of labor (worker to means of labor to objects of labor), the location of the worker, or the place where the direct interaction between the tool of labor and the object of labor occurs?

It would seem that the last-mentioned principle corresponds to the essence of the matter to the greatest degree. First of all, it agrees with the indication given by K. Marx concerning the content of labor as a process that is completed between man and nature, as the influence exerted by man upon outer nature[10], which influence occurs at the place where the tool and the object of labor are united. This understanding also corresponds to the greatest degree with the practical tasks. Actually, if one assumes as the boundary of the proportions, for example, the entire length of the technological chian in the process of labor, then in a number of instances the substantial differences in the production conditions along that chain will disappear. For the same reason the boundary that runs along the worker's location is also unacceptable: the drilling of wells, say, to a depth of 100 meters or 10,000 meters would pertain to the same vertical tier.

Accounting for the vertical proportions when planning presupposes the study of their underlying natural laws and tendencies, the substantiation of the factors, criteria, and methods of their formation; the ascertaining of forms and measures of interrelationship with the territorial and branch proportions requires the appropriate statistical base[11], etc.

Fig. 1 shows a sample classification of the proportions in the horizontal level. Forming its basis, as was already mentioned, is the ecological nonhomogeneity (state of differentiation) of the natural resources and the labor conditions along the vertical, and the system of social division of labor which is based upon it. Ecological nonhomogeneity is a condition for the variety of the forms and the difference in scale in the ecological processes, which can be divided into global, regional, and local[12]. Correspondingly, the proportions in the horizontal level, taking into consideration the relationship and the interdependence between the economy and the ecology, can also be divided arbitrarily into three groups: global, zonal, and local.

The global proportions are the correlation in the distribution of the social labor among the extraterrestrial, "pellicular," and terrestrial spheres. An example of zonal proportions is provided by the correlation between air space and outer space, the zone above the ground and below the ground, the zone above the water and below the water. Within each zone there exist local proportions which are determined by the specific nature of the ecological conditions and production activity within the given spatial boundaries. In conformity with the given classification, for example, transportation as a single branch of material production is reflected by the proportions of a different horizontal level: global (between air and other types of underground and surface transportation), zonal (between motor, water, and pipeline transportation), and local (between motor, rail, and elevator transportation and a subway).

The new aspect that is forming in national-economic activities -- the vertical aspect -- does not, in any manner, reduce the role of, replace, or eliminate the branch, territorial, or program aspects. By harmoniously combining with them, it supplements, develops, and renders concrete the other aspects, making it possible to reflect more completely the variety of conditions in production activity.

The vertical-zonal aspect already is partially finding its embodiment in the planning and organization of control. For example, air transport and mining production enties in planning practice and in statistical reports have been placed in independent branches, and subterranean operations are being regulated by special legislation[13]. During the planning, accounting, and financing of capital investments, deep drilling for petroleum and gas is also reflected in a special manner in geological prospecting. Activities involving the mastery of outer space are carried out in accordance with a special program.

In our opinion, a question that is of vital importance in improving planning is the accounting of aspect being considered, by isolating multistory construction, the construction of subterranean projects, the further differentiation of the horizontal levels of mining operations, the activities to be carried out in air and outer space, etc.

A schematic representation of the basic aspects of the national-economic plan from the positions that we are proposing is shown in Fig. 2.

Scientific interest in the problem of vertical zonality consists primarily in the ascertaining and study of the natural laws and tendencies in the distribution of the material-substantial conditions of labor and the financial resources by horizontal levels, the involvement of natural resources in circulation, the study of the factors that determine the development of social-production activity in various zones. The practical importance of the planning of proportions in the horizontal level lies in optimizing the distribution of the mentioned prerequisites for production by zones, with the purpose of the complete increase in the effectiveness and quality of the operations, the creation of ecological conditions for the workers' labor, everyday, and recreational life which conform adequately to mature socialism.

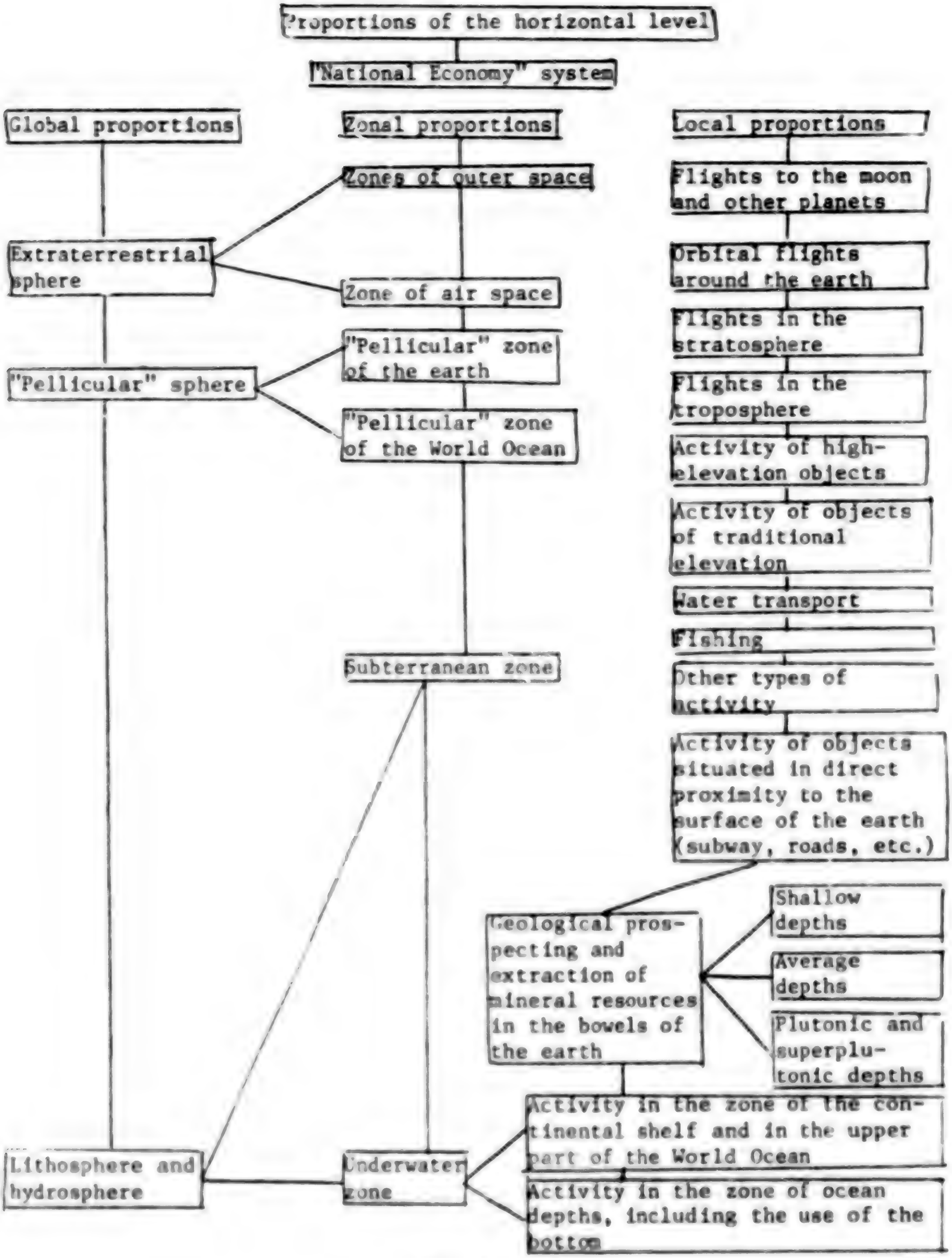
Proportions of the horizontal level
"National Economy" system
Global proportions
Zonal proportions
Local proportions
Zones of outer space
Flights to the moon and other planets
Extraterrestrial sphere
Orbital flights around the earth
Zone of air space
Flights in the stratosphere
"Pellicular" zone of the earth
"Pellicular" sphere
Flights in the troposphere
"Pellicular" zone of the World Ocean
Activity of high-elevation objects
Activity of objects of traditional elevation
Water transport
Fishing
Subterranean zone
Other types of activity
Activity of objects situated in direct proximity to the surface of the earth (subway, roads, etc.)
Shallow depths
Geological prospecting and extraction of mineral resources in the bowels of the earth
Average depths
Plutonic and superplutonic depths
Activity in the zone of the continental shelf and in the upper part of the World Ocean
Lithosphere and hydrosphere
Underwater zone
Activity in the zone of ocean depths, including the use of the bottom

Fig. 1

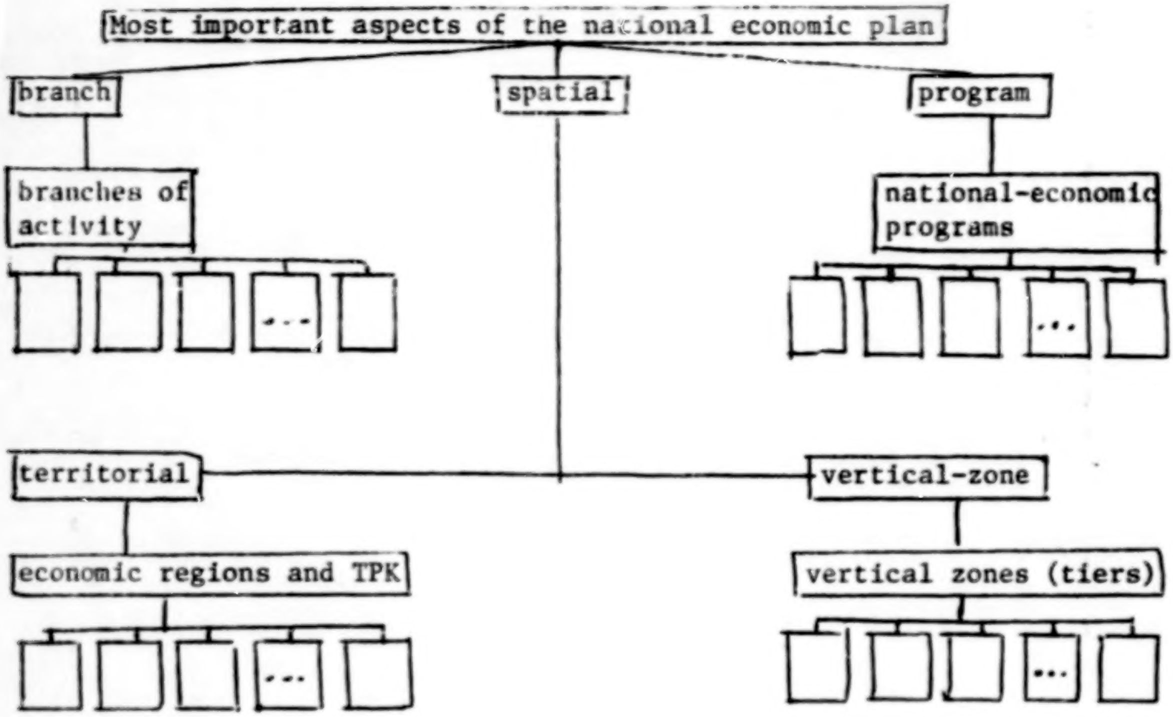

Fig. 2

The question of the proportionality in the development of the national economy and the assimilation of the natural resources in the cross-section view of the vertical zones is closely intertwined with the problems of branch planning and especially the regional distribution. Let us attempt to formulate the basic problems of the distribution of the productive forces along the vertical[14]:

-- the determination, by stages of improvement, of the economic proportions in the horizontal level;

-- the formation of new national-economic complexes on the basis of the concentration of the use along the vertical of various types of natural resources;

-- the complete use of the achievements of science and technology in the mastery of the resources contained in the bowels of the earth, the water environment, and air and outer space;

-- the creation of an economic mechanism for regulating the assimilation of the natural resources and the protection of the environment along the vertical;

-- the development of the scientific principles of the planned administration of the interaction between nature and society during the assimilation of the natural resources at the various vertical levels.

FOOTNOTES

1. See *Materialy XXV s"yezda KPSS* [Materials of the 25th CPSU Congress], Moscow, 1976, p 152.

2. Marks [Marx], F., Engel's [Engels], F., *Soch.* [Works], 2nd edition, Vol 25, Part II, p 342.

3. See: Dryazgov, M., "The Crisis of Pellicular Cities and the Three-Dimensional City of the Future," NAUKA I ZHIZN', No 7, 1978, p 100.

4. From the German word Raum -- space, area, place.

5. See *Moskva v tsifrakh (1917-1977 gg.)* [Moscow in Figures (1917-1977), Moscow, 1977, p 121.

6. See: Tonskoy D., G., *Zhilishchnoye stroitel'stvo v yevropeyskikh stranakh SEV* [Housing Construction in the European CEMA Countries], Moscow, 1974, p 43; Kapustyan, Ye. D., *Mnogoetazhnyye zhilyye doma* [Multistory Apartment Buildings], Moscow, 1975, p 13.

7. See *SSSR v tsifrakh v 1978 godu* [USSR in Figures in 1978], Moscow, 1979, p 153.

8. See: Zaytsev, A., "Outer Space for the National Economy," PLANOVOYE KHOZYAYSTVO, No 8, 1966, pp 126-128.

9. See GORNYY ZHURNAL, No 4, 1975, p 29; Margulov, R. D., Selikhova, Ye. V., Furman, I. Ya., *Razvitiye gazovoy promyshlennosti i analiz tekhniko-ekonomicheskikh pokazateley* [Development of the Gas Industry and the Analysis of Technical-Economic Indices], Moscow, 1976, p 11.

10. See: Marks, K., Engel's, F., *Soch.*, 2nd edition, Vol 23, p 138.

11. In this regard it would appear to be timely to pose the question of reflecting in statistical reports the technical-economic indices of the mining production entities in an interval-by-interval cross-section view, by tiers (see: Fershter, Ya. M., *Ekonomicheskoye issledovaniye vliyaniya glubiny na uroven' tekhniko-ekonomicheskikh pokazateley bureniya neftyanykh i gazovykh skvazhin* [Economic Research on the Influence of Depth Upon the Level of the Technical-Economic Indices of the Drilling of Petroleum and Gas Wells], Moscow, 1974).

12. See: Gerasimov, I., Budyko, M., "Vital Problems in the Interaction Between Man and Nature," KOMMUNIST, No 10, 1974, p 81.

13. See, for example: "Regulations Governing the Discipline of Workers Employed in Operations Under Especially Dangerous Subterranean Conditions," as approved by decree of the USSR Council of Ministers, 30 October 1976 (SPP SSSR [Collection of USSR Decrees and Orders?], No 1, 1977).

14. At one time there was a formulation of the basic problems of the regional policy of the placement of the productive forces (see: Nekrasov, N. N., "Problems of Territorial Economic Proportions," KOMMUNIST, No 10, 1970, p 82). It would seem that they also pertain to the placement of the productive forces along the vertical, with a consideration of the peculiar nature of this form of placement.

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